PRICE $2.00

HEATH COMPANY • BENTON HARBOR, MICHIGAN



HEATHKIT®
ASSEMBLY MANUAL

HEATHKIT®

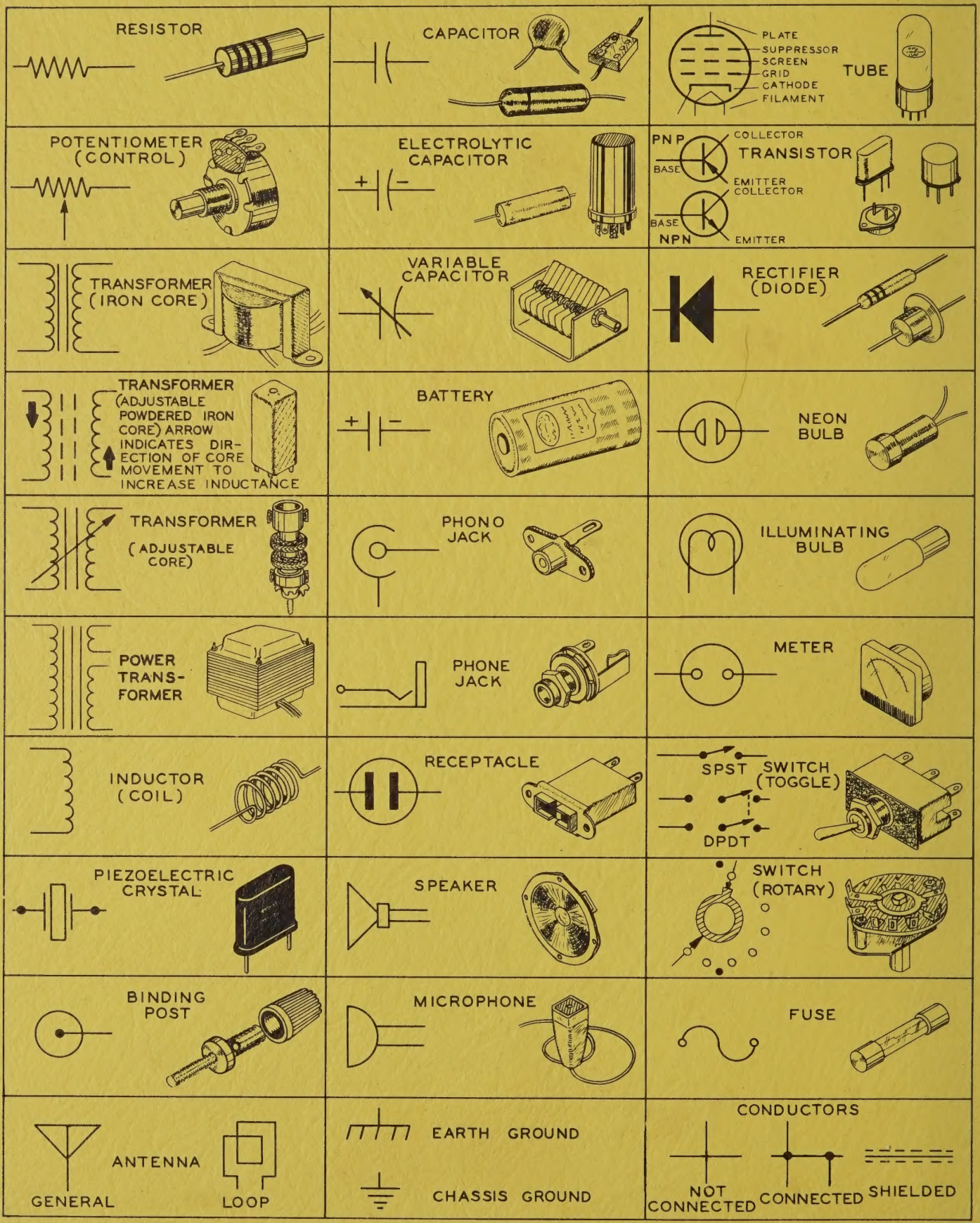
VECTORSCOPE
MODEL IO-101

595-1242-01

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TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.



Assembly
and
Operation
of the

HEATHKIT

VECTORSCOPE

MODEL IO-101



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INTRODUCTION

Your Heathkit Model IO-101 Vectorscope is a compact, all-solid-state instrument for servicing NTSC (National Television Systems Committee) color or black and white television receivers. It generates stable, crystal-controlled test signals to produce all the color and convergence patterns needed to accurately adjust color circuitry and tri-gun convergence systems. Twelve patterns plus a clear raster for purity adjustments can be produced. Dots, cross-hatch, horizontal lines, vertical lines, color bars, and gray scale patterns are available in either a 3 x 3 or 9 x 9 display.

The Vectorscope provides a characteristic waveform for each type of color TV receiver. This waveform is a voltage representation of all ten color bars in the form of a petal pattern on the Vectorscope screen. It is an exact representation of the chroma signal being fed to the guns of the CRT in the TV receiver. It will show a missing or weak color and provide a quick and accurate method of checking and adjusting the color circuits in the color TV receiver. The petal pattern shows the correct setting of the burst phase transformer, reactance coil, oscillator coil and bandpass adjustments. The color demodulation angle can also be checked.

The patterns may also be used to service black and white receivers since the vertical and horizontal sweep circuits and the black and white portion of the video signal are basically the same in both color and black and white receivers. The color bar patterns will appear as black and white bars on a black and white receiver.

Crystal-controlled horizontal and vertical sync pulses are incorporated into the Vectorscope output signals. These pulses provide the necessary blanking and lock the various patterns firmly on the television screen. The sync signals are also available at a front panel jack on the front panel of the Vectorscope.

RF output for channels 2 through 6 is available from the Vectorscope. The RF level control varies the RF output for checking relative sensitivity and to prevent overloading the RF and IF circuits of the receiver. A switched, crystal-controlled 4.5 MHz sound carrier aids in fine tuning the Vectorscope to the receiver channel frequency.

The video signal is available for troubleshooting video circuits and may be adjusted with the Video level control. The chroma signal is adjustable for amplitude and is used to check color hue and sync with different signal levels. Front panel switches are provided to turn the individual red, blue, and/or green beam currents on or off during convergence.

Solid-state circuitry is used for long life and trouble-free operation. The integrated circuits used in the divider chain eliminate the need for many adjustments and greatly increase the accuracy, stability, and reliability of this instrument.

Long-life silicon diode rectifiers are used in the zener-regulated power supply. The 120/240 VAC 50/60 Hz special copper-banded, low-flux-leakage power transformer prevents stray magnetic fields from disrupting the operation of the TV receiver under test.

Enclosed in an attractive cabinet, the Vectorscope is a versatile tool for workbench, laboratory, or "in-home" use.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

Check each part against the following parts list. Any part packaged in an individual envelope with a part number on it should be placed back in its envelope after it is identified until that part is called for in a step. The key numbers correspond to the numbers on the Parts Pictorial (fold-out from Page 5).

To order replacement parts, refer to the "Replacement Parts Price List" and use the Parts Order Form furnished with this kit.

RESISTORS

1/2 Watt

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
1	1-111*	3	150 Ω (brown-green-brown)
	1-4	1	330 Ω (orange-orange-brown)
	1-9	4	1000 Ω (brown-black-red)
	1-90*	2	2000 Ω (red-black-red)
	1-122*	2	3300 Ω (orange-orange-red)
	1-46	4	3900 Ω (orange-white-red)
	1-43*	3	4700 Ω (yellow-violet-red)
	1-113*	1	5600 Ω (green-blue-red)
	1-105*	5	10 kΩ (brown-black-orange)
	1-21	2	15 kΩ (brown-green-orange)
	1-58*	2	22 kΩ (red-red-orange)
	1-124*	1	27 kΩ (red-violet-orange)
	1-76*	3	33 kΩ (orange-orange-orange)
	1-47	1	56 kΩ (green-blue-orange)
	1-26	3	100 kΩ (brown-black-yellow)
	1-29	1	220 kΩ (red-red-yellow)
	1-30	1	270 kΩ (red-violet-yellow)
	1-31	3	330 kΩ (orange-orange-yellow)
	1-37	3	2.2 MΩ (red-red-green)

Other Resistors

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
2	1-28-1	3	100 kΩ 1 watt (brown-black-yellow)
3	3-7-5*	2	11 Ω 5 watt, wire-wound

*5%

CAPACITORS

Resin

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
4	20-52	2	7.5 pF
	20-99	2	22 pF
	20-101	1	47 pF
	20-76	1	68 pF
	20-108	1	200 pF
	20-106	2	390 pF
	20-113	2	470 pF
	20-107	2	680 pF

Disc

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
5	21-115	1	9 pF
	21-14	1	.001 µF
6	21-27	11	.005 µF
7	21-44	2	.005 µF 1600 V

Electrolytic

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
8	25-147	1	10 µF tubular
9	25-115	2	10 µF vertical mounting
10	25-132	2	20 µF
11	25-148	3	1000 µF

Other Capacitors

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
12	23-29	1	.1 µF tubular
13	26-130	1	Variable
14	27-28	1	.1 µF Mylar**
15	31-36	3	8-50 pF trimmer

** DuPont Registered Trademark

CONTROLS-SWITCHES

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
16	10-201	1	10 kΩ miniature control
17	12-105	2	500 kΩ/500 kΩ control
18	19-147	1	10 kΩ/200 Ω control with switch
19	19-148	1	2000 Ω (2 k) control with switch
	19-149	1	250 kΩ control with switch
20	60-55	1	4PDT slide switch
21	60-45	3	SPST rocker switch
22	60-40	1	3PDT rocker switch
23	63-472	1	Rotary switch

CLIPS-SOCKETS-JACK

24	260-1	3	Alligator clip (plain)
	260-52	3	Insulation-piercing alligator clip
25	434-41	1	CRT socket
26	434-148	2	AC power socket
27	432-144	140	Connector
28	436-24	1	White banana jack

TERMINAL STRIPS

29	431-39	1	5-lug (small)
30	431-50	1	1-lug
31	431-10	1	3-lug
32	431-5	1	4-lug
33	431-11	2	5-lug (large)
34	431-82	1	Terminal collar

DIODES-CRYSTALS-LAMP

35	56-20	6	Crystal diode, 1N295 (red-white-green)
36	56-50	1	3.6 V zener diode
37	57-27	2	Silicon diode, 1N2071
38	57-52	1	Silicon diode, 2 kV 5 mA
39	404-3	1	3.563 795 MHz (3.56 MHz) crystal
	404-4	1	4.500 MHz (4.5 MHz) crystal
	404-343	1	190.08 kHz crystal
40	412-15	1	Neon lamp, NE-2H

TUBE-TRANSISTORS-INTEGRATED CIRCUITS

	411-142	1	3RP1A CRT

NOTE: Transistors and integrated circuits are marked for identification in one of the following four ways:

1. Part number.
2. Transistor or integrated circuit type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

41	417-108	10	2N3692 transistor
42	417-116	2	S2091 (2N3638) transistor
43	417-173	1	NPN transistor
44	443-9	7	MC790P integrated circuit Dual J-K flip-flop
	443-10	1	MC723P integrated circuit Single J-K flip-flop
	443-21	2	MC717P integrated circuit Quadruple 2-input NAND/NOR gate

WIRE-CABLE-SLEEVING

89-23	1	3-wire line cord
134-230	1	Wiring harness
340-8	1	Small bare wire
340-11	1	Large bare wire
343-9	1	Shielded cable
347-38	1	4-wire cable
346-4	1	Small sleeving
346-20	1	1/4" heat-shrinkable sleeving

CUSHION STRIP-INSULATORS-STRAIN RELIEFS

45	73-5	1	Cushion strip
46	73-20	1	Red alligator clip insulator
	73-21	5	Black alligator clip insulator
47	75-29	1	4-wire cable strain relief
48	75-71	1	Flat line cord strain relief
49	75-107	1	Shielded cable strain relief

CONTROLS-SWITCHES

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
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23	63-472	1	Rotary switch

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KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
24	260-1	3	Alligator clip (plain)
	260-52	3	Insulation-piercing alligator clip
25	434-41	1	CRT socket
26	434-148	2	AC power socket
27	432-144	140	Connector
28	436-24	1	White banana jack

TERMINAL STRIPS

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
29	431-39	1	5-lug (small)
30	431-50	1	1-lug
31	431-10	1	3-lug
32	431-5	1	4-lug
33	431-11	2	5-lug (large)
34	431-82	1	Terminal collar

DIODES-CRYSTALS-LAMP

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
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36	56-50	1	3.6 V zener diode
37	57-27	2	Silicon diode, 1N2071
38	57-52	1	Silicon diode, 2 kV 5 mA
39	404-3	1	3.563 795 MHz (3.56 MHz) crystal
	404-4	1	4.500 MHz (4.5 MHz) crystal
	404-343	1	190.08 kHz crystal
40	412-15	1	Neon lamp, NE-2H

TUBE-TRANSISTORS-INTEGRATED CIRCUITS

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
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	443-10	1	MC723P integrated circuit Single J-K flip-flop
	443-21	2	MC717P integrated circuit Quadruple 2-input NAND/NOR gate

WIRE-CABLE-SLEEVING

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
	89-23	1	3-wire line cord
	134-230	1	Wiring harness
	340-8	1	Small bare wire
	340-11	1	Large bare wire
	343-9	1	Shielded cable
	347-38	1	4-wire cable
	346-4	1	Small sleeving
	346-20	1	1/4" heat-shrinkable sleeving

CUSHION STRIP-INSULATORS-STRAIN RELIEFS

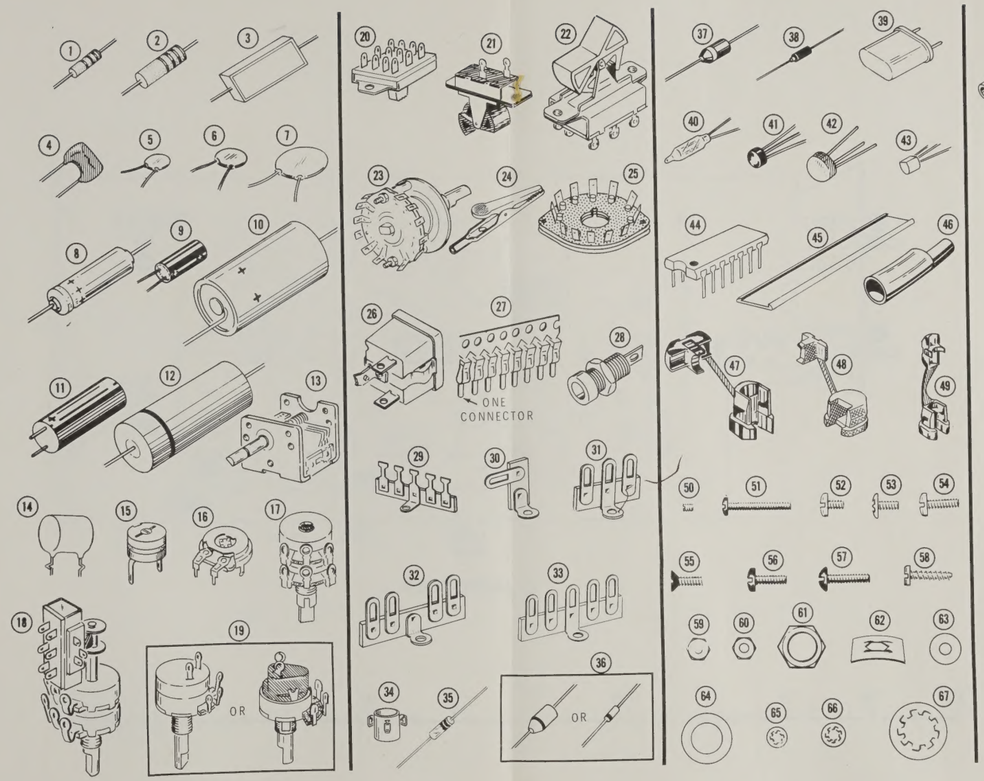
KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
45	73-5	1	Cushion strip
46	73-20	1	Red alligator clip insulator
	73-21	5	Black alligator clip insulator
47	75-29	1	4-wire cable strain relief
48	75-71	1	Flat line cord strain relief
49	75-107	1	Shielded cable strain relief

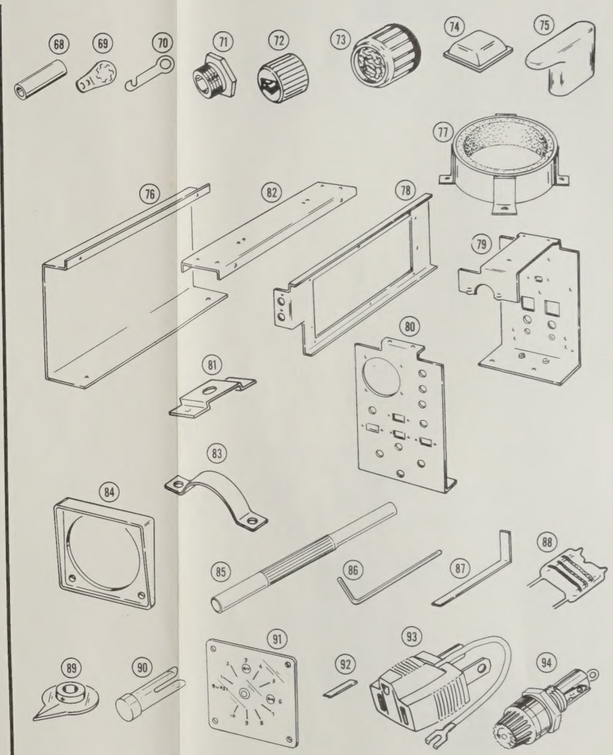
KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
HARDWARE			
NOTE: The hardware is shown full size for your convenience.			
50	250-156	2	4-40 x 1/8" setscrew
51	250-389	10	4-40 x 3/4" black screw
52	250-138	5	6-32 x 3/16" screw
53	250-229	12	6-32 x 1/4" phillips head screw
54	250-89	8	6-32 x 3/8" screw
55	250-276	2	6-32 x 3/8" black flat head screw
56	250-381	7	6-32 x 3/8" black screw
57	250-250	4	6-32 x 1/2" black screw
58	250-284	10	#6 x 1/2" sheet metal screw
59	252-2	2	4-40 nut
60	252-3	17	6-32 nut
61	252-7	7	Control nut
62	252-32	1	Push-on speednut
63	253-60	8	#6 flat washer
64	253-10	7	Control flat washer
65	254-9	2	#4 lockwasher
66	254-1	22	#6 lockwasher
67	254-4	4	Control lockwasher
68	255-15	8	#6 x 1/2" spacer
69	259-1	2	#6 solder lug (large)
70	259-6	3	#6 solder lug (small)

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
METAL PARTS			
76	90-476	2	Cabinet half-shell
77	100-329	1	CRT ring
78	200-572	1	Side panel
79	203-690	1	Rear panel
80	203-689	1	Front panel
81	204-816	1	Tuning capacitor mounting bracket
82	204-819	1	Top rail
83	207-1	2	CRT clamp
84	210-12-2	1	CRT bezel
TOOLS			
85	490-5	1	Nut starter
86	490-23	1	Allen wrench
87	490-111	1	IC puller
MISCELLANEOUS			
88	40-581	2	620 μH coil (blue-red-brown)
	54-248	1	Power transformer
	85-336-4	1	Divider circuit board
	85-297-1	1	Video-RF circuit board
89	100-694	2	Dial pointer
	211-35	1	Handle and end mounts
90	413-10	1	Lamp lens
91	414-20	1	Graticule
92	205-778	1	1/8" x 1" metal strip
93	432-27	1	Power plug adapter
	421-33	1	1/4-ampere slow-blow fuse
94	423-1	1	Fuseholder
	391-54	1	Heathkit nameplate
	391-34	1	Blue and white label
	597-308	1	Kit Builders Guide
	597-260	1	Parts Order Form
		1	Manual (See front cover for part number.)
			Solder

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
BUSHINGS-KNOBS-FEET			
71	455-38	1	Shaft bushing
72	455-50	7	Knob insert
73	462-246	2	Large knob
	462-250	5	Small knob
74	261-28	4	Foot
75	261-39	4	Line cord retainer

PARTS PICTORIAL





STEP-BY-STEP ASSEMBLY

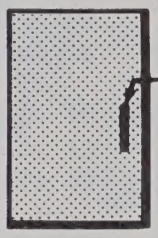
Before you start the circuit board assembly, be sure to read the Circuit Board Parts Mounting and Soldering sections (Pages 11, 12, and 13) of the "Kit Builders Guide."

Resistors will be called out by their resistance value in Ω or kΩ, and color code. Use 1/2 watt resistors unless directed otherwise.

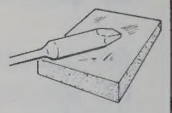
Capacitors will be called out by their capacitance value (in pF or μF) and type (disc, electrolytic, Mylar, or resin).

CIRCUIT BOARD ASSEMBLY

IDENTIFICATION DRAWING



FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...
WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

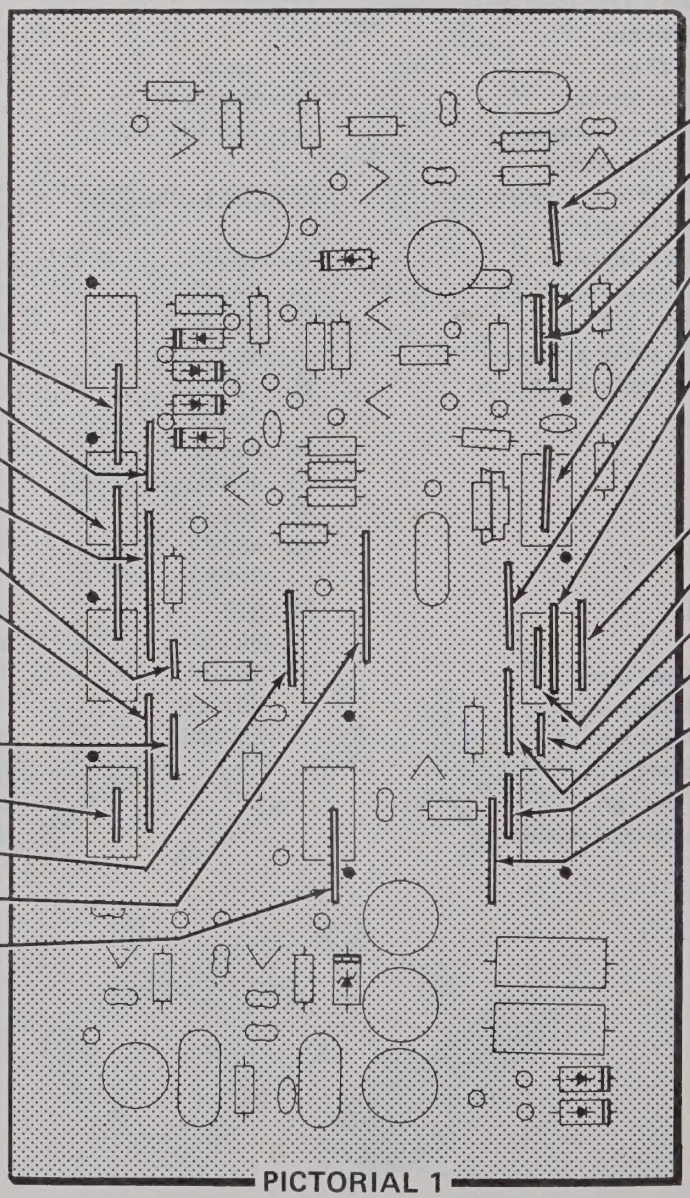


START

Position the divider circuit board with the part number as shown in the identification drawing. Then complete each step on the Pictorial.

NOTE: In the following steps, the jumper wires will be installed on the circuit board. Use small bare hookup wire and cut it to the length specified. Be careful that you do not bridge solder between two adjacent foils on the circuit board when you make a connection.

- ( ) 1-1/4" bare wire.
- ( ) 1" bare wire.
- ( ) 1-3/4" bare wire.
- ( ) 1-3/4" bare wire.
- ( ) 3/4" bare wire.
- ( ) 1-1/2" bare wire.
- ( ) Solder the wires to the foil and cut off the excess lead lengths.
- ( ) 1" bare wire.
- ( ) 7/8" bare wire.
- ( ) 1-1/4" bare wire.
- ( ) 1-1/2" bare wire.
- ( ) 1-1/4" bare wire.
- ( ) Solder the wires to the foil and cut off the excess lead lengths.

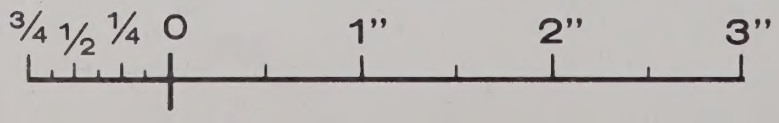


PICTORIAL 1

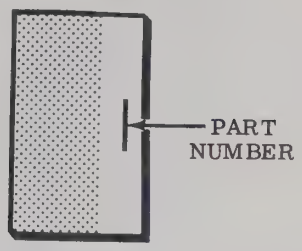
CONTINUE

- ( ) 1" bare wire.
- ( ) 1-1/4" bare wire.
- ( ) 1" bare wire.
- ( ) 1-1/8" bare wire.
- ( ) 1-1/8" bare wire.
- ( ) 1-1/8" bare wire.
- ( ) Solder the wires to the foil and cut off the excess lead lengths.
- ( ) 1-1/8" bare wire.
- ( ) 1" bare wire.
- ( ) 3/4" bare wire.
- ( ) 1-1/4" bare wire.
- ( ) 1" bare wire.
- ( ) 1-1/4" bare wire.
- ( ) Solder the wires to the foil and cut off the excess lead lengths.
- ( ) Check to see that twenty-three jumper wires are installed and properly soldered to the foil. Be sure these wires do not touch one another on the lettered side of the circuit board.

PROCEED TO PICTORIAL 2



IDENTIFICATION DRAWING

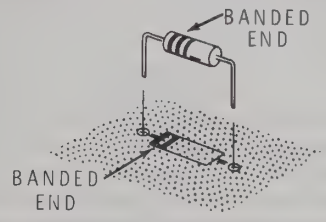


START

( ) 3300 Ω (orange-orange-red).

( ) 15 kΩ (brown-green-orange).

NOTE: When you install the crystal diodes in the following steps, be sure to position the banded end as shown on the circuit board.



( ) Crystal diode (red-white-green).

( ) Crystal diode (red-white-green).

( ) Crystal diode (red-white-green).

( ) Crystal diode (red-white-green).

( ) 3300 Ω (orange-orange-red).

( ) Solder the leads to the foil and cut off the excess lead lengths.

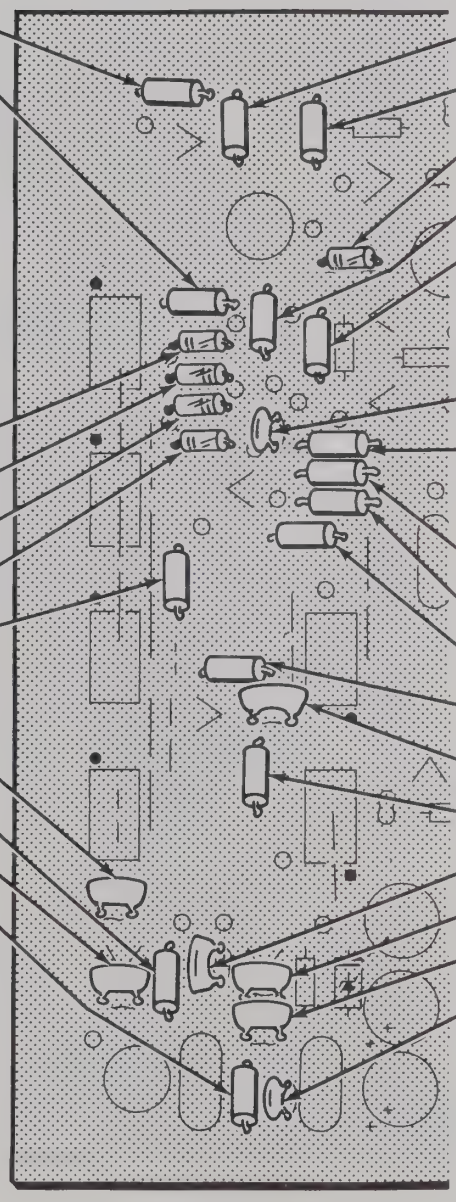
( ) 390 pF resin.

( ) 10 kΩ (brown-black-orange).

( ) 680 pF resin.

( ) 2000 Ω (red-black-red).

( ) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

( ) 100 kΩ (brown-black-yellow).

( ) 3900 Ω (orange-white-red).

( ) Crystal diode (red-white-green). Note the location of the banded-end.

( ) 10 kΩ (brown-black-orange).

( ) 1000 Ω (brown-black-red).

NOTE: Do not use the .005 μF 1600 V (1.6 kV) disc capacitors until directed to do so in a step.

( ) .005 μF disc.

( ) 56 kΩ (green-blue-orange).

( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) 1000 Ω (brown-black-red).

( ) 4700 Ω (yellow-violet-red).

( ) 3900 Ω (orange-white-red).

( ) 1000 Ω (brown-black-red).

( ) 470 pF resin.

( ) 15 kΩ (brown-green-orange).

( ) 7.5 pF resin.

( ) 680 pF resin.

( ) 390 pF resin.

( ) 9 pF disc.

( ) Solder the leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 3.

PICTORIAL 2

IDENTIFICATION DRAWING



KEEP YOUR SOLDERING IRON TIP CLEAN

START

(✓) 22 pF resin.

(✓) 33 kΩ (orange-orange-orange).

(✓) 47 pF resin.

(✓) 4700 Ω (yellow-violet-red).

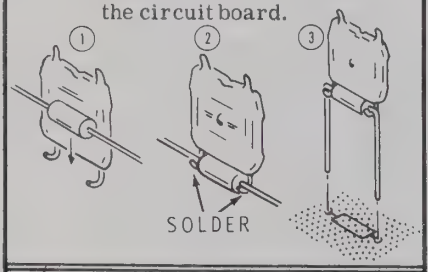
(✓) 27 kΩ (red-violet-orange).

(✓) 100 kΩ (brown-black-yellow).

(✓) 4700 Ω (yellow-violet-red).

(✓) 2000 Ω (red-black-red) resistor and 620 μH coil. Prepare the combination as follows:

1. Bend the leads of the coil as shown.
2. Install the resistor in these bent leads. Solder both connections.
3. Install this combination on the circuit board.

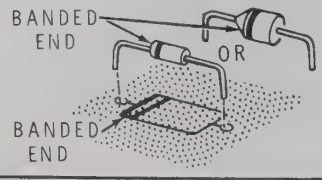


(✓) .1 μF Mylar.

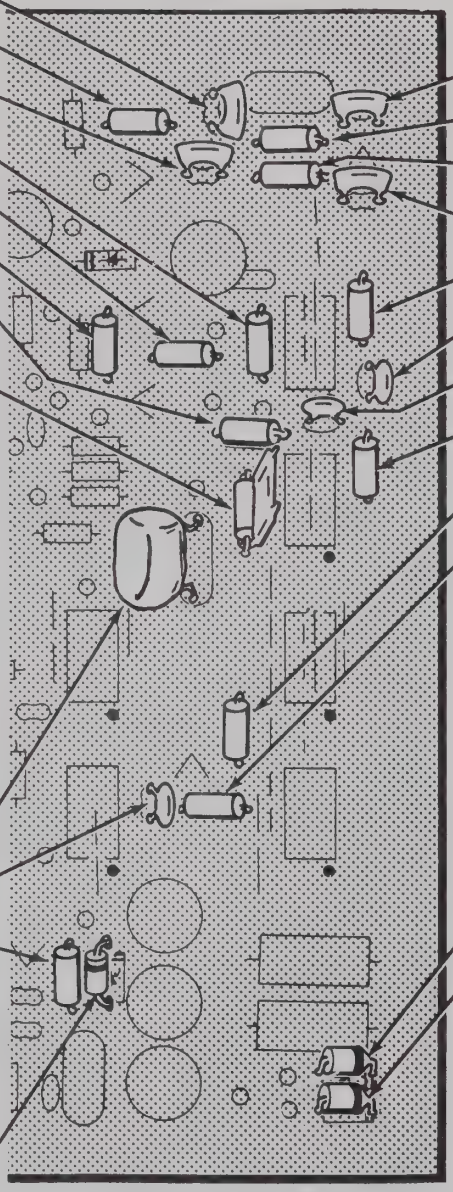
(✓) .001 μF disc.

(✓) 10 kΩ (brown-black-orange).

(✓) Zener diode (#56-50). Be sure to position the banded end as shown on the circuit board.



(✓) Solder the leads to the foil and cut off the excess lead lengths.



CONTINUE

(✓) 470 pF resin.

(✓) 270 kΩ (red-violet-yellow).

(✓) 22 kΩ (red-red-orange).

(✓) 22 pF resin.

(✓) 3900 Ω (orange-white-red).

(✓) .005 μF disc.

(✓) .005 μF disc.

(✓) 3900 Ω (orange-white-red).

(✓) 150 Ω (brown-green-brown).

(✓) 1000 Ω (brown-black-red).

NOTE: When you install the diodes in the next two steps, be sure you position the cathode end as shown. The cathode end will be marked with a color dot, color band, or color end.



(✓) Silicon diode (#57-27).

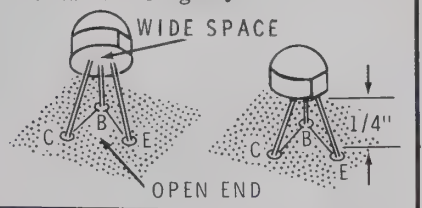
(✓) Silicon diode (#57-27).

(✓) Solder the leads to the foil and cut off the excess lead lengths.

PROCEED TO PICTORIAL 4.

PICTORIAL 3

NOTE: In the following steps, install the transistors as follows: Note the wide space between the leads on the bottom of the transistor. Position this wide space over the open end of the outline on the circuit board. Insert the transistor leads into their correct holes which are indicated by C, B, and E. Position the transistor approximately 1/4" above the circuit board. Then solder the leads to the foil and cut off the excess lead lengths.



(✓) 2N3692 transistor (#417-108).

(✓) 2N3692 transistor (#417-108).

(✓) 2N3692 transistor (#417-108).

(✓) 2N3692 transistor (#417-108).

(✓) 2N3692 transistor (#417-108).

(✓) S2091 transistor (#417-116). Install this transistor in the same manner as above.

(✓) 2N3692 transistor (#417-108).

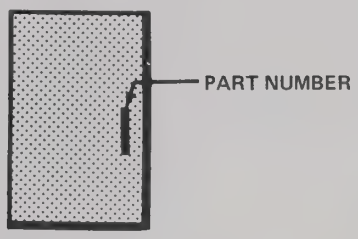
(✓) 2N3692 transistor (#417-108).

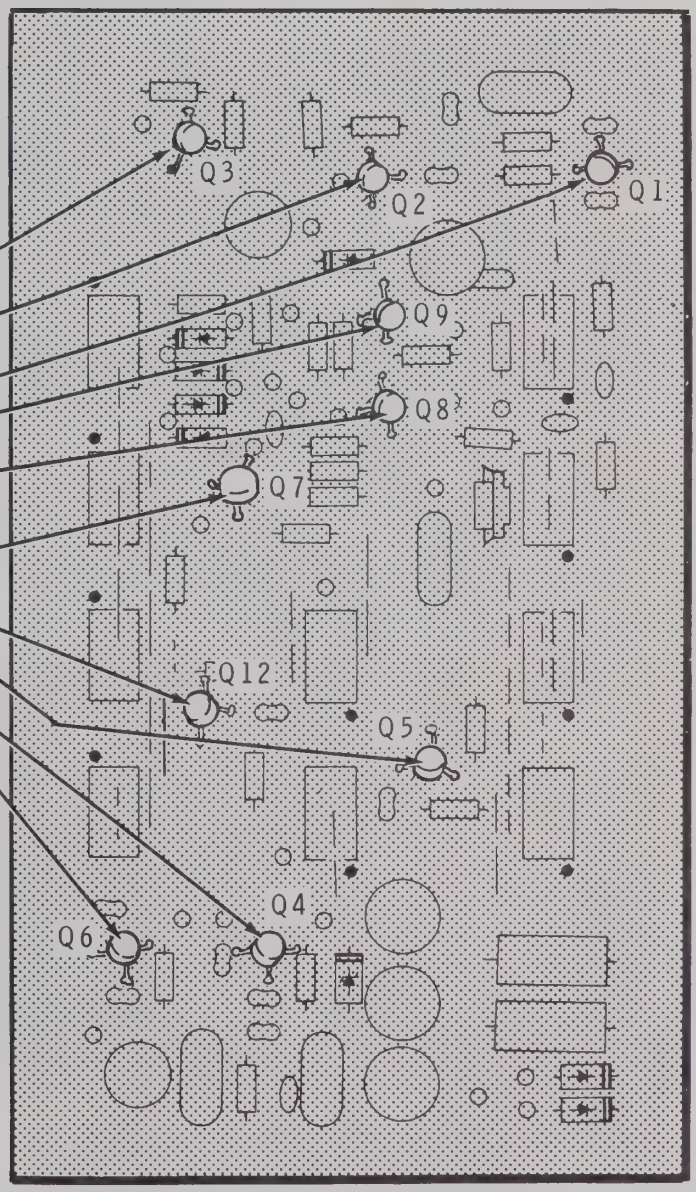
(✓) 2N3692 transistor (#417-108).

(✓) 2N3692 transistor (#417-108).

PROCEED TO PICTORIAL 5.

IDENTIFICATION DRAWING



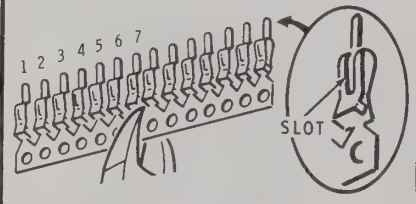


PICTORIAL 4



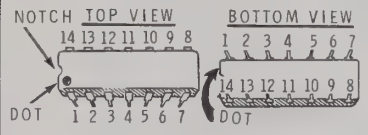
START

( ) Cut off twenty (20) strips of seven connectors. Note the numbering of the connectors. Do not remove the individual connectors until directed to do so.

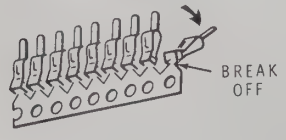


NOTES:

1. A dot or notch on the top of the IC designates pin 1. Refer to the pin numbering illustration below.

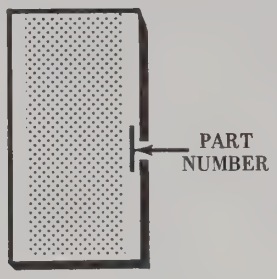


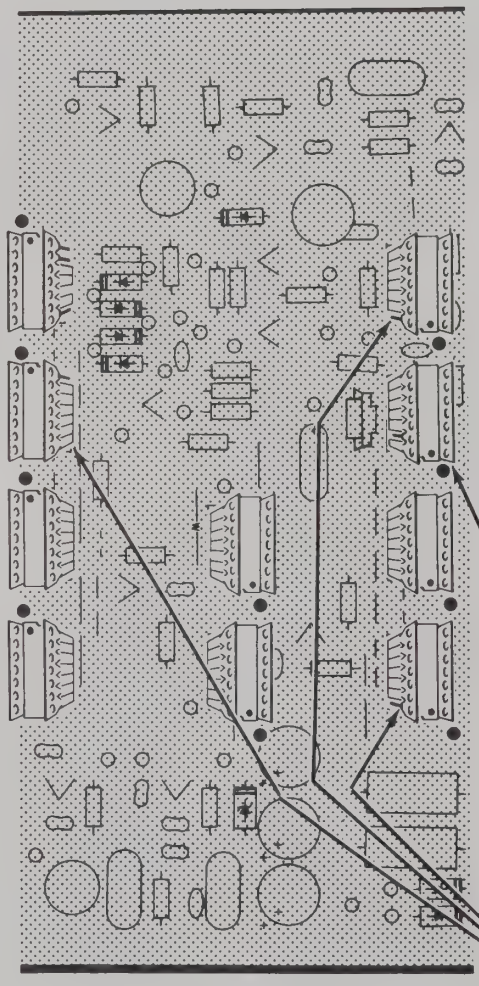
2. When it is necessary to remove one or more of the connectors from the strip, bend the connector back until it breaks off. Do not remove the pins from the integrated circuits.



3. Solder the connectors to the foil as each IC is installed.

IDENTIFICATION DRAWING



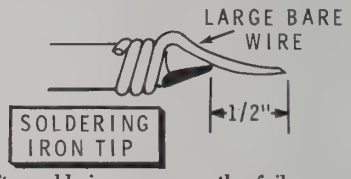


PICTORIAL 5

CONTINUE

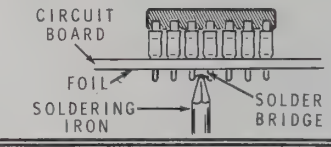
Use a small-tip soldering iron. Since the IC connectors are close together, do not place the soldering iron tip between them, as this increases the possibility of a solder bridge.

If a small-tip soldering iron is not available, turn off your soldering iron and allow it to cool. Then, wrap the large bare wire, supplied with this kit, tightly around the soldering iron tip. Allow approximately 1/2" of wire to extend beyond the end of the soldering iron.



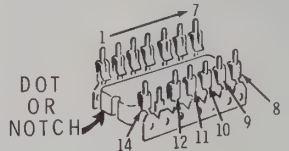
After soldering, compare the foil area with the X-Ray View (fold-out from Page 75) to be sure there are no solder bridges.

If a solder bridge occurs, turn the circuit board foil-side down and hold the soldering iron tip between the two points that are bridged. The solder will flow down the tip of the soldering iron.



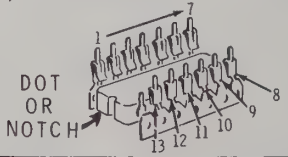
Prepare a #443-9 IC as follows:

(✓) Install a strip of connectors on pins 1 through 7.
(✓) Remove connector #6 from a strip of connectors.
(✓) Install this strip on pins 8, 9, 10, 11, 12, and 14 of the IC.
(✓) Install the IC on the circuit board.



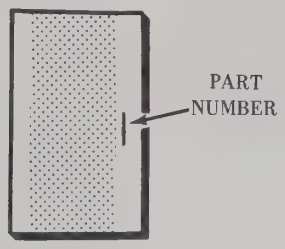
Prepare three #443-9 IC's as follows:

(✓) Install a strip of connectors on pins 1 through 7.
(✓) Remove connector #7 from a strip of connectors.
(✓) Install this strip on pins 8 through 13 of the IC.
(✓) Install the IC's on the circuit board.



PROCEED TO PICTORIAL 6.

IDENTIFICATION DRAWING



START

Prepare a #443-10 IC as follows:

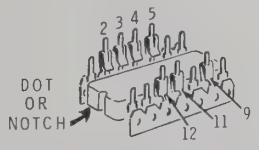
( ) Remove connectors #1, #6, and #7 from a strip of connectors.

( ) Install this strip on pins 2, 3, 4, and 5 of the IC.

( ) Remove connectors #1, #3, #6, and #7 from a strip of connectors.

( ) Install this strip on pins 9, 11, and 12 of the IC.

( ) Install the IC on the circuit board.

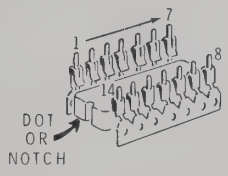


Prepare three #443-9 IC's as follows:

( ) Install a strip of connectors on pins 1 through 7.

( ) Install a strip of connectors on pins 8 through 14.

( ) Install the IC's on the circuit board.

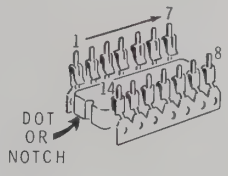


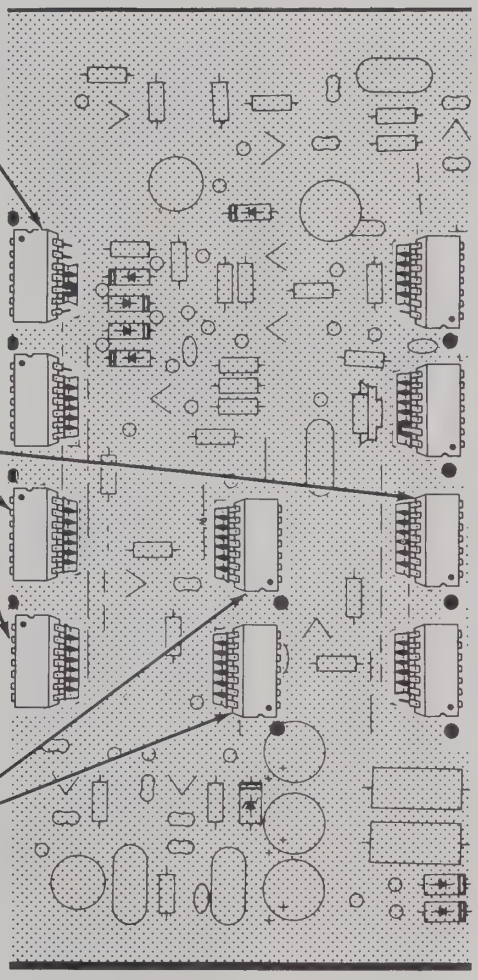
Prepare two #443-21 IC's as follows:

( ) Install a strip of connectors on pins 1 through 7.

( ) Install a strip of connectors on pins 8 through 14.

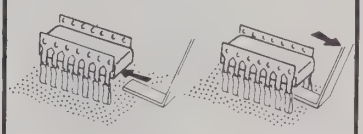
( ) Install the IC's on the circuit board.



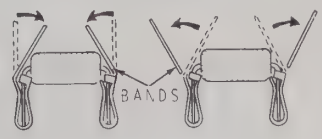


CONTINUE

NOTE: An IC puller has been included with this kit so you do not bend the pins when you remove an IC from its connectors. To use the puller, insert its foot beneath the IC; then gently rock the tool back and forth to lift the IC.



( ) Remove the bands that join the connectors. Do this by first bending the band toward the integrated circuit; then bend it outward as shown.



PROCEED TO PICTORIAL 7.

PICTORIAL 6

START

NOTE: Solder the leads of each part to the foil as it is installed, and cut off the excess lead lengths of only the resistors and electrolytic capacitors.

(✓) 190.08 kHz crystal.

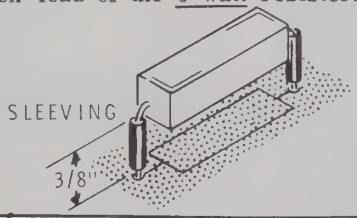
(✓) Trimmer capacitor.



(✓) Cut the indicated lug off the 10 kΩ control (#10-201) as shown. Then install the control on the circuit board.



NOTE: In the next two steps, place a 3/8" length of small sleeving over each lead of the 5 watt resistors.



(✓) 11 Ω 5 watt resistor.

(✓) 11 Ω 5 watt resistor.

(✓) 8-50 pF trimmer.

(✓) 3563.795 kHz (3.56 MHz) crystal.

(✓) 4500.000 kHz (4.5 MHz) crystal.

NOTE: When you install the following electrolytic capacitors, be sure you match the positive (+) marking on the capacitor with the positive (+) marking on the circuit board.



(✓) 1000 μF electrolytic.

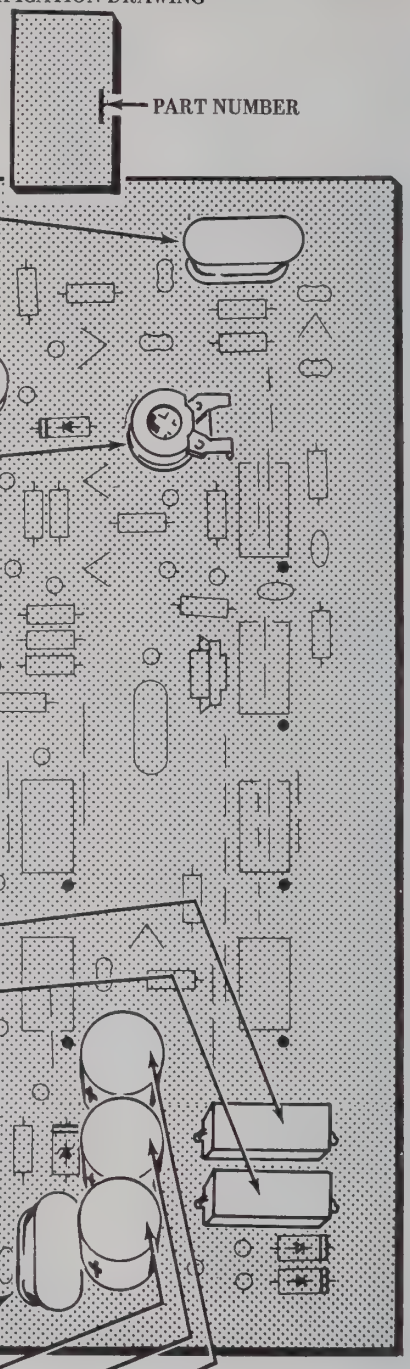
(✓) 1000 μF electrolytic.

(✓) 1000 μF electrolytic.

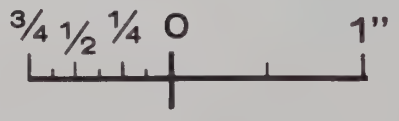
FINISH

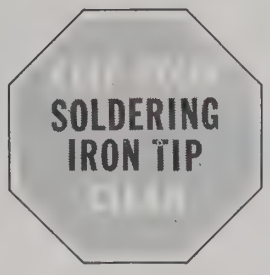
Set the circuit board aside temporarily. Proceed to Pictorial 8.

IDENTIFICATION DRAWING



PICTORIAL 7



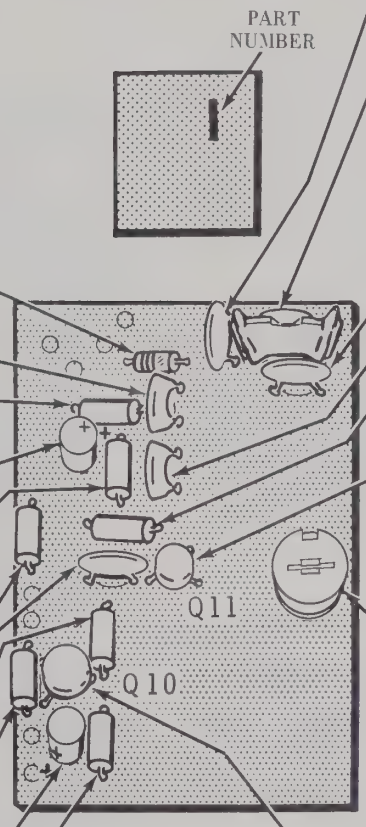


START

Position the Video-RF circuit board as shown in Pictorial 8 and complete the following steps.

- (✓) Crystal diode (red-white-green). Be sure to position the banded end as shown.
- (✓) 7.5 pF resin.
- (✓) 10 kΩ (brown-black-orange).
- (✓) 10 μF electrolytic. Position the positive (+) marking on the capacitor as shown.
- (✓) 22 kΩ (red-red-orange).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.
- (✓) 150 Ω (brown-green-brown).
- (✓) .005 μF disc.
- (✓) 33 kΩ (orange-orange-orange).
- (✓) 150 Ω (brown-green-brown).
- (✓) 10 μF electrolytic. Position the positive (+) marking on the capacitor as shown.
- (✓) 10 kΩ (brown-black-orange).
- (✓) Solder the leads to the foil and cut off the excess lead lengths.

IDENTIFICATION DRAWING

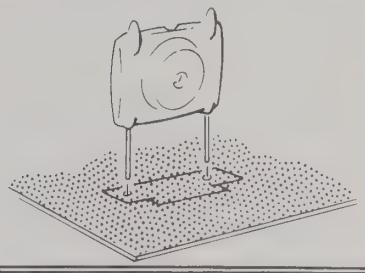


PICTORIAL 8

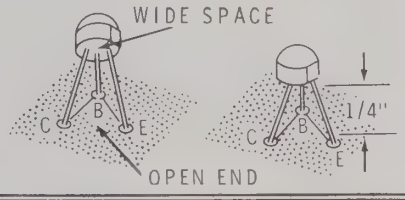
CONTINUE

NOTE: Solder the leads of each part to the foil as it is installed, and cut off the excess lead lengths unless otherwise indicated.

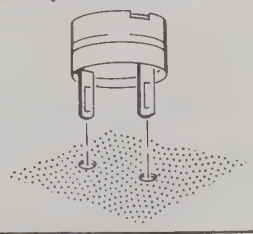
- (✓) .005 μF disc.
- (✓) 620 μH coil (blue-red-brown).



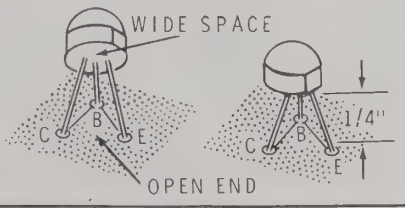
- (✓) .005 μF disc.
- (✓) 68 pF resin.
- (✓) 330 Ω (orange-orange-brown).
- (✓) 2N3692 transistor (#417-108).



- (✓) Trimmer capacitor. Solder the lugs to the foil. Do not cut the lugs off.



- (✓) S2091 transistor (#417-116).



- (✓) Check to be sure all leads are soldered to the foil.

Set the circuit board aside temporarily. Proceed to Page 14.

SIDE PANEL PREPARATION

Refer to Pictorial 9 (fold-out from Page 15) for the following steps.

( ) Locate the side panel and position it as shown.

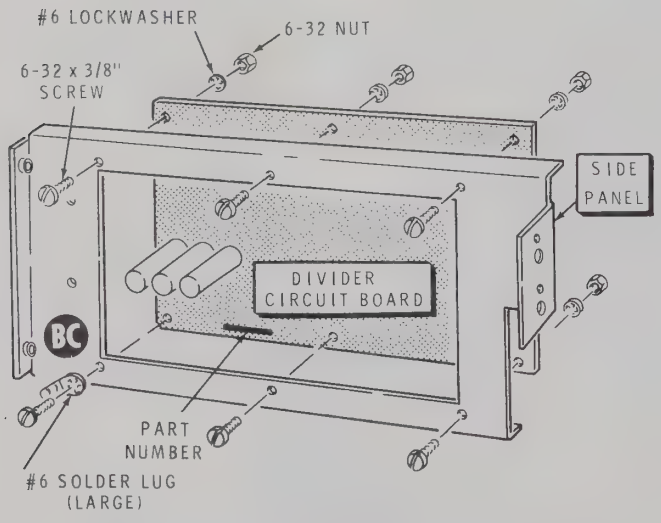
NOTES:

1. The Heath Company has provided a plastic nut starter with this kit. Use this nut starter to hold and start 6-32 and 4-40 nuts on screws. Refer to the "Kit Builders Guide" for further information.

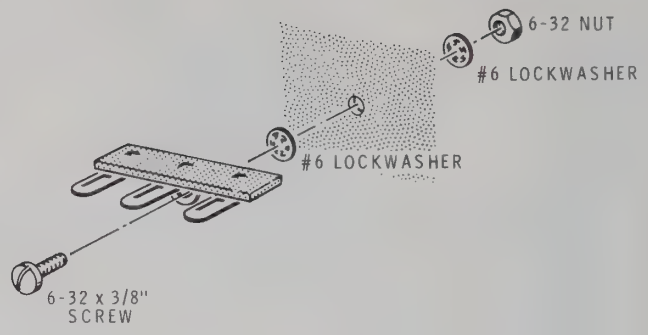
2. The term "hardware" will be used to refer to the screws, nuts, and lockwashers when parts are being mounted in some of the following steps. The phrase "Use 6-32 x 3/8" hardware," for example, means to use a 6-32 x 3/8" screw, one or more #6 lockwashers, and a 6-32 nut. Refer to the Detail called out in the step for the correct number of lockwashers to use and the correct way to install the hardware.

3. Do not use the black hardware until specifically called for in a step.

(✓) Refer to Detail 9A and mount the divider circuit board to the side panel. Position the part number towards the bottom of the side panel. Use 6-32 x 3/8" hardware, with a #6 solder lug (large) at BC as shown.



Detail 9A



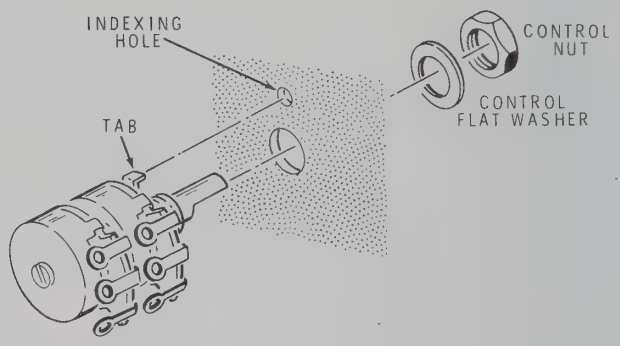
Detail 9B

(✓) Refer to Detail 9B and mount a 3-lug terminal strip at BA. Use 6-32 x 3/8" hardware.

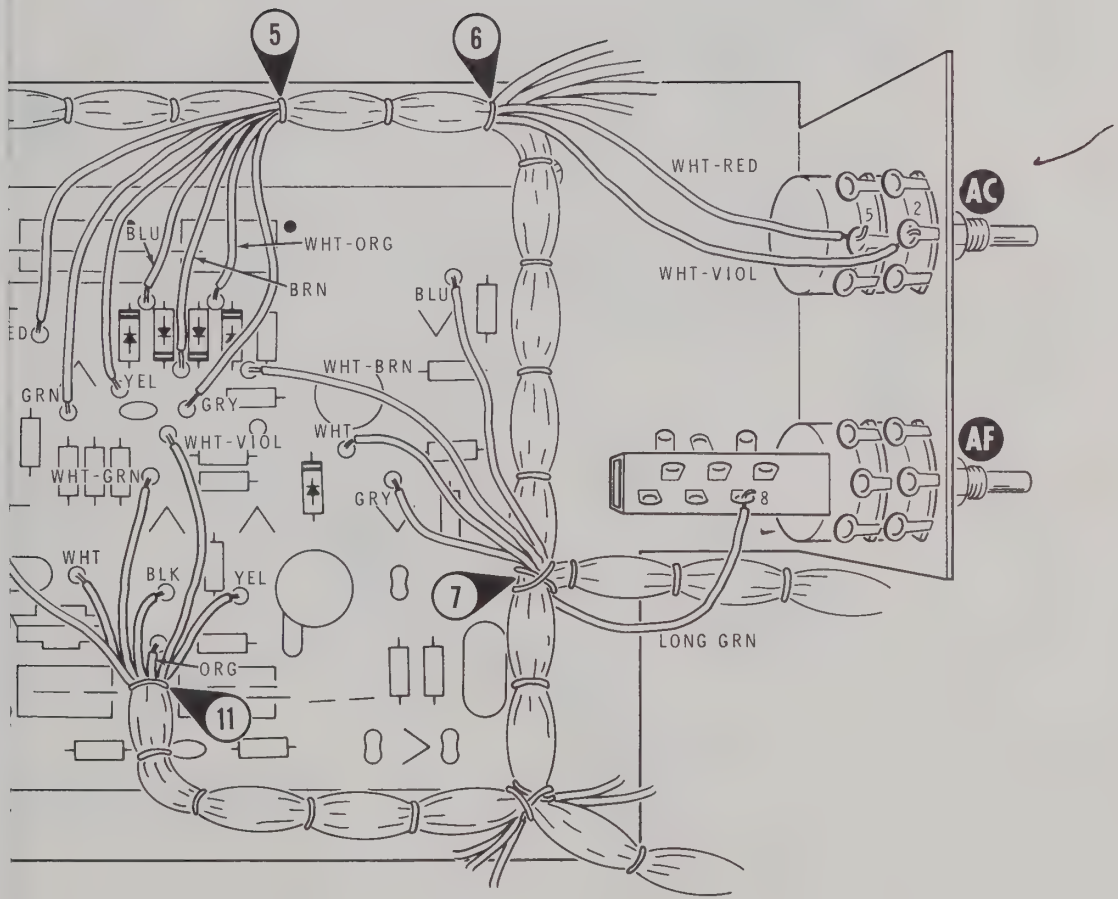
(✓) Likewise, install a 1-lug terminal strip at BB.

(✓) Refer to Detail 9C and install a 500 kΩ/500 kΩ control (#12-105) at AC. Use a control flat washer and a control nut. Position the tab on the control in the indexing hole in the side panel.

(✓) Install a 10 kΩ/200 Ω control (#19-147) at AF. Use a control flat washer and a control nut. Position the tab on the control in the indexing hole in the side panel.



Detail 9C



TORIAL 10

5" 6" 7" 8" 9" 10"

SIDE PANEL PREPARATION

Refer to Pictorial 9 (fold-out from Page 15) for the following steps.

( ) Locate the side panel and position it as shown.

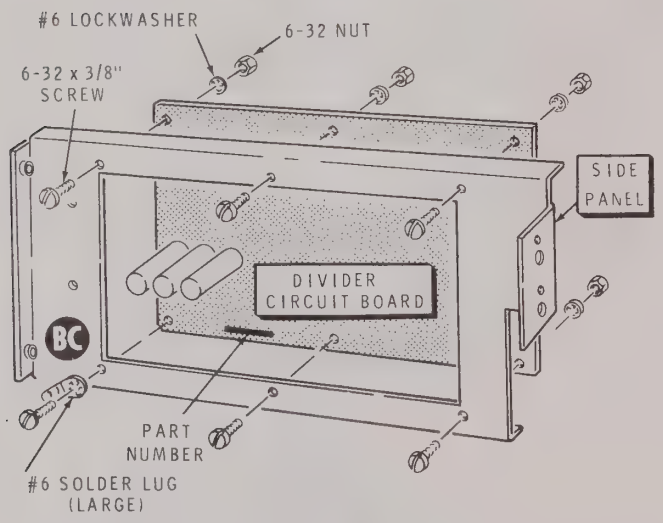
NOTES:

1. The Heath Company has provided a plastic nut starter with this kit. Use this nut starter to hold and start 6-32 and 4-40 nuts on screws. Refer to the "Kit Builders Guide" for further information.

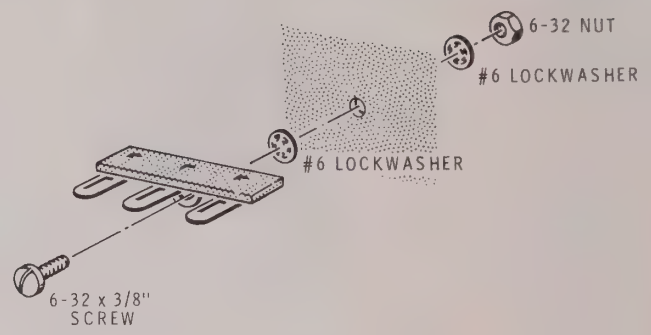
2. The term "hardware" will be used to refer to the screws, nuts, and lockwashers when parts are being mounted in some of the following steps. The phrase "Use 6-32 x 3/8" hardware," for example, means to use a 6-32 x 3/8" screw, one or more #6 lockwashers, and a 6-32 nut. Refer to the Detail called out in the step for the correct number of lockwashers to use and the correct way to install the hardware.

3. Do not use the black hardware until specifically called for in a step.

(✓) Refer to Detail 9A and mount the divider circuit board to the side panel. Position the part number towards the bottom of the side panel. Use 6-32 x 3/8" hardware, with a #6 solder lug (large) at BC as shown.



Detail 9A



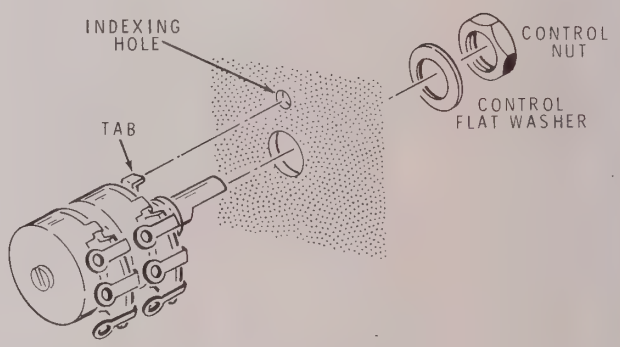
Detail 9B

(✓) Refer to Detail 9B and mount a 3-lug terminal strip at BA. Use 6-32 x 3/8" hardware.

(✓) Likewise, install a 1-lug terminal strip at BB.

(✓) Refer to Detail 9C and install a 500 kΩ/500 kΩ control (#12-105) at AC. Use a control flat washer and a control nut. Position the tab on the control in the indexing hole in the side panel.

(✓) Install a 10 kΩ/200 Ω control (#19-147) at AF. Use a control flat washer and a control nut. Position the tab on the control in the indexing hole in the side panel.



Detail 9C

Refer to Detail 10A for the following steps.

( ) Position the wiring harness as shown. Cut off the following lengths of wire from the wires at BO#1 (breakout #1). Save these cut-off wires; they will be used later.

2-1/2" brown
4" green
7" red
28" blue

( ) Remove 1/4" of insulation from the ends of the brown, green, red, and blue wires of BO#1.

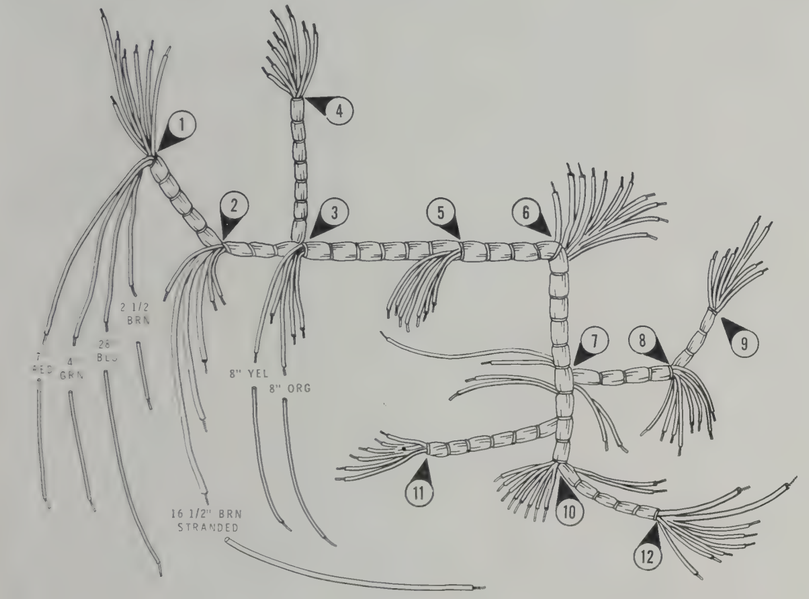
( ) Cut off 16-1/2" of the brown stranded wire from BO#2. Save this cut-off wire; it will be used later.

( ) Remove 1/4" of insulation from the end of the brown stranded wire of BO#2.

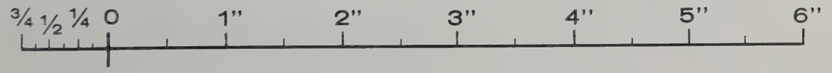
( ) Cut off the following lengths of wire from the ends of the wires at BO#3. Save these cut-off wires; they will be used later.

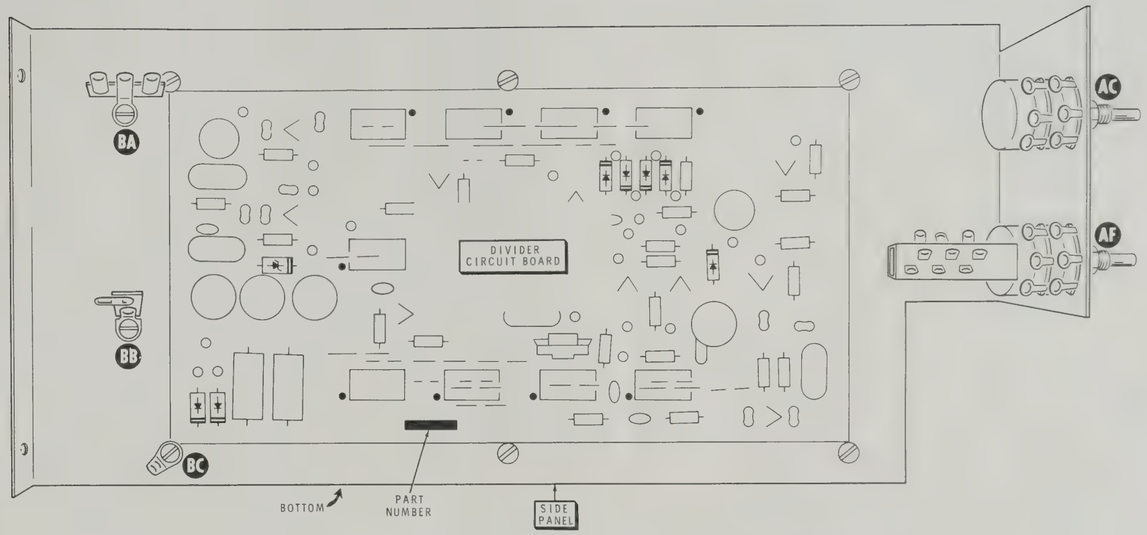
8" orange
8" yellow

( ) Remove 1/4" of insulation from the ends of the orange and yellow wires of BO#3.

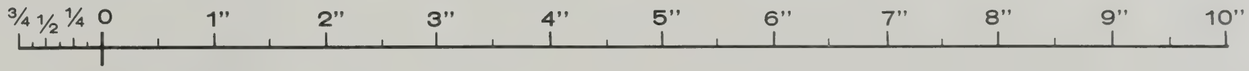


Detail 10A





PICTORIAL 9



Refer to Pictorial 10 for the following steps.

( ) Place the wiring harness on the chassis as shown.

NOTE: In the following steps, cut off the excess wire lengths as each wire is soldered to the circuit board foil.

Connect the wires from BO#2 to terminal strip BA as follows:

( ) Both white-gray to lug 1 (NS).

( ) Green to lug 2 (S-1).

The remaining wires from BO#2 will be connected later.

Connect the wires from BO#3 to the circuit board as follows:

( ) Orange to ORG (S-1).

( ) White-blue to WHT/BLU (S-1).

( ) Yellow to YEL (S-1).

( ) White-orange to WHT/ORG (S-1).

( ) Violet to VIOL (S-1).

Connect the wires from BO#5 to the circuit board as follows:

( ) Blue to BLU (S-1).

( ) White-red to WHT/RED (S-1).

( ) Green to GRN (S-1).

( ) Yellow to YEL (S-1).

( ) Brown to BRN (S-1).

( ) White-orange to WHT/ORG (S-1).

( ) Gray to GRY (S-1).

Connect the wires from BO#6 to control AC as follows:

( ) White-red to lug 5 (S-1).

( ) White-violet to lug 2 (S-1).

The remaining wires from BO#6 will be connected later.

Connect the wires from BO#7 to the circuit board as follows:

( ) Gray to GRY (S-1).

( ) White to WHT (S-1).

( ) White-brown to WHT/BRN (S-1).

( ) Blue to BLU (S-1).

( ) Connect the longer green wire to lug 8 of control AF (S-1).

The remaining wire from BO#7 will be connected later.

Connect the wires from BO#11 to the circuit board as follows:

( ) Orange to ORG (S-1).

( ) Black to BLK (S-1).

( ) Yellow to YEL (S-1).

( ) White to WHT (S-1).

( ) White-green to WHT/GRN (S-1).

( ) White-violet to WHT/VIOL (S-1).

( ) White-yellow to WHT/YEL (S-1).

( ) Locate the CRT socket and position it as shown.

Connect the wires from BO#4 to the CRT socket as follows:

NOTE: The lugs of the CRT socket are numbered clockwise as viewed from the back of the socket. Lug 1 is the first lug to the right of the keyway.

( ) Green to lug 2 (S-1).

( ) White-brown to lug 3 (NS).

( ) White-green to lug 4 (S-1).

( ) White to lug 6 (S-1).

( ) Gray to lug 7 (S-1).

( ) White-red to lug 8 (S-1).

( ) Black to lug 9 (S-1).

( ) Brown to lug 10 (S-1).

( ) Position the wiring harness so that it does not interfere with the operation of switch AF.

Refer to Pictorial 11 (fold-out from Page 17) for the following steps.

NOTE: If the length of large bare wire has wrapped around the soldering iron tip in a previous step, turn off the soldering iron and allow it to cool; then remove the wire, as it will not be needed in the following steps.

( ) Connect the lead from the banded end of a silicon diode (#57-52) to lug 1 of terminal strip BA (NS). Connect the other lead of this diode to lug 3 of terminal strip BA (NS).

( ) Connect the positive (+) lead of a 20 μF electrolytic capacitor to lug 1 of terminal strip BA (S-4). Connect the other lead of this capacitor to lug 1 of terminal strip BB (NS).

( ) Connect the positive (+) lead of a 20 μF electrolytic capacitor to lug 1 of terminal strip BB (S-2). Connect the other lead of this capacitor to solder lug BC (S-1).

( ) Connect a 330 kΩ (orange-orange-yellow) resistor between lug 1 (NS) and lug 4 (NS) of control AC.

When wiring this kit, you will be instructed to prepare lengths of hookup wire ahead of time, as in the following step. To prepare a wire, cut it to the indicated length; then remove 1/4" of insulation from each end. When stranded wire is called for, melt a small amount of solder on the bare wire ends to hold the small wire strands together. The wires are listed in the order in which they will be used.

NOTE: When hookup wire is called for in the following steps, use the lengths of wire previously cut from the wiring harness. When bare wire is called for, use the length of bare wire supplied with the kit.

( ) Prepare the following lengths of hookup wire.

1" bare	3-1/2" yellow
1-1/2" blue	4" green
3-1/2" yellow	2-1/2" brown
3" blue	3-1/2" orange
1" bare	4" red
3-1/2" orange	2-1/2" red
2-1/2" blue	

( ) Connect a 1" bare wire between lug 6 (S-1) and lug 3 (NS) of control AC.

( ) Connect a 1-1/2" blue wire between lug 1 (NS) and lug 3 (S-2) of the CRT socket.

( ) Connect the remaining prepared wires to control AF in the following steps.

( ) Connect one end of a 3-1/2" yellow wire to lug 1 (S-1). The other end will be connected later.

( ) Connect one end of a 3" blue wire to lug 3 (S-1). The other end will be connected later.

( ) Connect one end of a 1" bare wire to lug 4 (NS). Solder the other end of this wire to the side of the switch as shown. Cut off the excess wire length.

( ) Connect one end of a 3-1/2" orange wire to lug 4 (S-2). The other end will be connected later.

( ) Connect a 1-1/2" blue wire between lug 5 (S-1) and lug 15 (S-1).

( ) Connect one end of a 3-1/2" yellow wire to lug 6 (S-1). The other end will be connected later.

( ) Twist together the orange wire from lug 4 and the yellow wire from lug 6 of control AF.

( ) Connect one end of a 4" green wire to lug 7 (S-1). The other end will be connected later.

( ) Connect one end of a 2-1/2" brown wire to lug 9 (S-1). The other end will be connected later.

( ) Connect one end of a 3-1/2" orange wire to lug 10 (S-1). The other end will be connected later.

( ) Connect one end of a 4" red wire to lug 11 (S-1). Connect the other end of this wire to the circuit board hole marked RED (S-1).

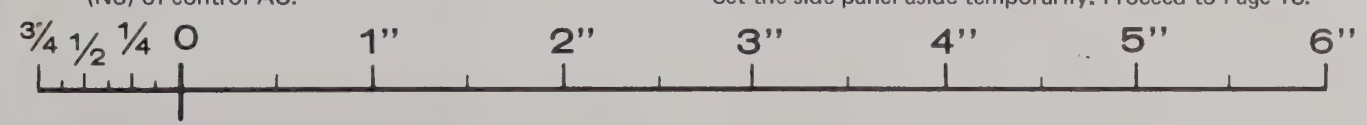
( ) Connect one end of a 2-1/2" red wire to lug 12 (S-1). The other end will be connected later.

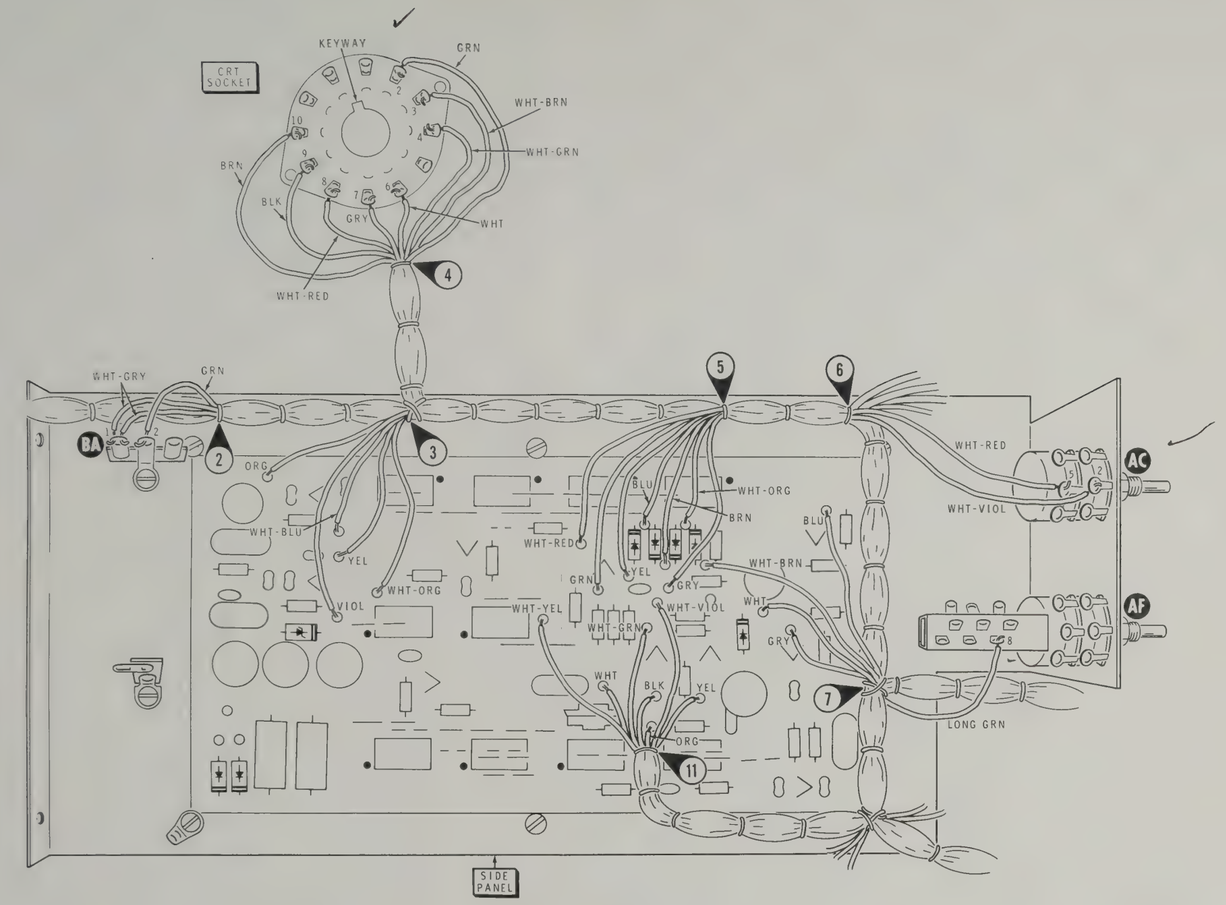
( ) Place a 3/4" length of sleeving on each lead of a 10 μF tubular electrolytic capacitor.

( ) Connect the positive (+) lead to lug 13 of control AF (S-1). Connect the other lead to lug 2 of control AF (S-1). Position this capacitor against the control as shown.

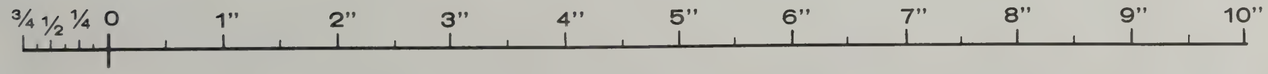
( ) Cut off any excess lead lengths that may extend from the foil side of the circuit board.

Set the side panel aside temporarily. Proceed to Page 18.





PICTORIAL 10



Refer to Pictorial 10 for the following steps.

( ) Place the wiring harness on the chassis as shown.

NOTE: In the following steps, cut off the excess wire lengths as each wire is soldered to the circuit board foil.

Connect the wires from BO#2 to terminal strip BA as follows:

( ) Both white-gray to lug 1 (NS).

( ) Green to lug 2 (S-1).

The remaining wires from BO#2 will be connected later.

Connect the wires from BO#3 to the circuit board as follows:

( ) Orange to ORG (S-1).

( ) White-blue to WHT/BLU (S-1).

( ) Yellow to YEL (S-1).

( ) White-orange to WHT/ORG (S-1).

( ) Violet to VIOL (S-1).

Connect the wires from BO#5 to the circuit board as follows:

( ) Blue to BLU (S-1).

( ) White-red to WHT/RED (S-1).

( ) Green to GRN (S-1).

( ) Yellow to YEL (S-1).

( ) Brown to BRN (S-1).

( ) White-orange to WHT/ORG (S-1).

( ) Gray to GRY (S-1).

Connect the wires from BO#6 to control AC as follows:

( ) White-red to lug 5 (S-1).

( ) White-violet to lug 2 (S-1).

The remaining wires from BO#6 will be connected later.

Connect the wires from BO#7 to the circuit board as follows:

( ) Gray to GRY (S-1).

( ) White to WHT (S-1).

( ) White-brown to WHT/BRN (S-1).

( ) Blue to BLU (S-1).

( ) Connect the longer green wire to lug 8 of control AF (S-1).

The remaining wire from BO#7 will be connected later.

Connect the wires from BO#11 to the circuit board as follows:

( ) Orange to ORG (S-1).

( ) Black to BLK (S-1).

( ) Yellow to YEL (S-1).

( ) White to WHT (S-1).

( ) White-green to WHT/GRN (S-1).

( ) White-violet to WHT/VIOL (S-1).

( ) White-yellow to WHT/YEL (S-1).

( ) Locate the CRT socket and position it as shown.

Connect the wires from BO#4 to the CRT socket as follows:

NOTE: The lugs of the CRT socket are numbered clockwise as viewed from the back of the socket. Lug 1 is the first lug to the right of the keyway.

( ) Green to lug 2 (S-1).

( ) White-brown to lug 3 (NS).

( ) White-green to lug 4 (S-1).

( ) White to lug 6 (S-1).

( ) Gray to lug 7 (S-1).

( ) White-red to lug 8 (S-1).

( ) Black to lug 9 (S-1).

( ) Brown to lug 10 (S-1).

( ) Position the wiring harness so that it does not interfere with the operation of switch AF.

Refer to Pictorial 11 (fold-out from Page 17) for the following steps.

NOTE: If the length of large bare wire has wrapped around the soldering iron tip in a previous step, turn off the soldering iron and allow it to cool; then remove the wire, as it will not be needed in the following steps.

( ) Connect the lead from the banded end of a silicon diode (#57-52) to lug 1 of terminal strip BA (NS). Connect the other lead of this diode to lug 3 of terminal strip BA (NS).

( ) Connect the positive (+) lead of a 20 μF electrolytic capacitor to lug 1 of terminal strip BA (S-4). Connect the other lead of this capacitor to lug 1 of terminal strip BB (NS).

( ) Connect the positive (+) lead of a 20 μF electrolytic capacitor to lug 1 of terminal strip BB (S-2). Connect the other lead of this capacitor to solder lug BC (S-1).

( ) Connect a 330 kΩ (orange-orange-yellow) resistor between lug 1 (NS) and lug 4 (NS) of control AC.

When wiring this kit, you will be instructed to prepare lengths of hookup wire ahead of time, as in the following step. To prepare a wire, cut it to the indicated length; then remove 1/4" of insulation from each end. When stranded wire is called for, melt a small amount of solder on the bare wire ends to hold the small wire strands together. The wires are listed in the order in which they will be used.

NOTE: When hookup wire is called for in the following steps, use the lengths of wire previously cut from the wiring harness. When bare wire is called for, use the length of bare wire supplied with the kit.

( ) Prepare the following lengths of hookup wire.

1" bare	3-1/2" yellow
1-1/2" blue	4" green
3-1/2" yellow	2-1/2" brown
3" blue	3-1/2" orange
1" bare	4" red
3-1/2" orange	2-1/2" red
2-1/2" blue	

( ) Connect a 1" bare wire between lug 6 (S-1) and lug 3 (NS) of control AC.

( ) Connect a 1-1/2" blue wire between lug 1 (NS) and lug 3 (S-2) of the CRT socket.

( ) Connect the remaining prepared wires to control AF in the following steps.

( ) Connect one end of a 3-1/2" yellow wire to lug 1 (S-1). The other end will be connected later.

( ) Connect one end of a 3" blue wire to lug 3 (S-1). The other end will be connected later.

( ) Connect one end of a 1" bare wire to lug 4 (NS). Solder the other end of this wire to the side of the switch as shown. Cut off the excess wire length.

( ) Connect one end of a 3-1/2" orange wire to lug 4 (S-2). The other end will be connected later.

( ) Connect a 1-1/2" blue wire between lug 5 (S-1) and lug 15 (S-1).

( ) Connect one end of a 3-1/2" yellow wire to lug 6 (S-1). The other end will be connected later.

( ) Twist together the orange wire from lug 4 and the yellow wire from lug 6 of control AF.

( ) Connect one end of a 4" green wire to lug 7 (S-1). The other end will be connected later.

( ) Connect one end of a 2-1/2" brown wire to lug 9 (S-1). The other end will be connected later.

( ) Connect one end of a 3-1/2" orange wire to lug 10 (S-1). The other end will be connected later.

( ) Connect one end of a 4" red wire to lug 11 (S-1). Connect the other end of this wire to the circuit board hole marked RED (S-1).

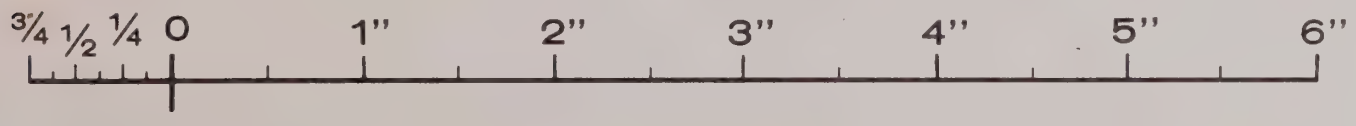
( ) Connect one end of a 2-1/2" red wire to lug 12 (S-1). The other end will be connected later.

( ) Place a 3/4" length of sleeving on each lead of a 10 μF tubular electrolytic capacitor.

( ) Connect the positive (+) lead to lug 13 of control AF (S-1). Connect the other lead to lug 2 of control AF (S-1). Position this capacitor against the control as shown.

( ) Cut off any excess lead lengths that may extend from the foil side of the circuit board.

Set the side panel aside temporarily. Proceed to Page 18.



Refer to Pictorial 10 for the following steps.

( ) Place the wiring harness on the chassis as shown.

NOTE: In the following steps, cut off the excess wire lengths as each wire is soldered to the circuit board foil.

Connect the wires from BO#2 to terminal strip BA as follows:

( ) Both white-gray to lug 1 (NS).

( ) Green to lug 2 (S-1).

The remaining wires from BO#2 will be connected later.

Connect the wires from BO#3 to the circuit board as follows:

( ) Orange to ORG (S-1).

( ) White-blue to WHT/BLU (S-1).

( ) Yellow to YEL (S-1).

( ) White-orange to WHT/ORG (S-1).

( ) Violet to VIOL (S-1).

Connect the wires from BO#5 to the circuit board as follows:

( ) Blue to BLU (S-1).

( ) White-red to WHT/RED (S-1).

( ) Green to GRN (S-1).

( ) Yellow to YEL (S-1).

( ) Brown to BRN (S-1).

( ) White-orange to WHT/ORG (S-1).

( ) Gray to GRY (S-1).

Connect the wires from BO#6 to control AC as follows:

( ) White-red to lug 5 (S-1).

( ) White-violet to lug 2 (S-1).

The remaining wires from BO#6 will be connected later.

Connect the wires from BO#7 to the circuit board as follows:

( ) Gray to GRY (S-1).

( ) White to WHT (S-1).

( ) White-brown to WHT/BRN (S-1).

( ) Blue to BLU (S-1).

( ) Connect the longer green wire to lug 8 of control AF (S-1).

The remaining wire from BO#7 will be connected later.

Connect the wires from BO#11 to the circuit board as follows:

( ) Orange to ORG (S-1).

( ) Black to BLK (S-1).

( ) Yellow to YEL (S-1).

( ) White to WHT (S-1).

( ) White-green to WHT/GRN (S-1).

( ) White-violet to WHT/VIOL (S-1).

( ) White-yellow to WHT/YEL (S-1).

( ) Locate the CRT socket and position it as shown.

Connect the wires from BO#4 to the CRT socket as follows:

NOTE: The lugs of the CRT socket are numbered clockwise as viewed from the back of the socket. Lug 1 is the first lug to the right of the keyway.

( ) Green to lug 2 (S-1).

( ) White-brown to lug 3 (NS).

( ) White-green to lug 4 (S-1).

( ) White to lug 6 (S-1).

( ) Gray to lug 7 (S-1).

( ) White-red to lug 8 (S-1).

( ) Black to lug 9 (S-1).

( ) Brown to lug 10 (S-1).

( ) Position the wiring harness so that it does not interfere with the operation of switch AF.

Refer to Pictorial 11 (fold-out from Page 17) for the following steps.

NOTE: If the length of large bare wire has wrapped around the soldering iron tip in a previous step, turn off the soldering iron and allow it to cool; then remove the wire, as it will not be needed in the following steps.

( ) Connect the lead from the banded end of a silicon diode (#57-52) to lug 1 of terminal strip BA (NS). Connect the other lead of this diode to lug 3 of terminal strip BA (NS).

( ) Connect the positive (+) lead of a 20 μF electrolytic capacitor to lug 1 of terminal strip BA (S-4). Connect the other lead of this capacitor to lug 1 of terminal strip BB (NS).

( ) Connect the positive (+) lead of a 20 μF electrolytic capacitor to lug 1 of terminal strip BB (S-2). Connect the other lead of this capacitor to solder lug BC (S-1).

( ) Connect a 330 kΩ (orange-orange-yellow) resistor between lug 1 (NS) and lug 4 (NS) of control AC.

When wiring this kit, you will be instructed to prepare lengths of hookup wire ahead of time, as in the following step. To prepare a wire, cut it to the indicated length; then remove 1/4" of insulation from each end. When stranded wire is called for, melt a small amount of solder on the bare wire ends to hold the small wire strands together. The wires are listed in the order in which they will be used.

NOTE: When hookup wire is called for in the following steps, use the lengths of wire previously cut from the wiring harness. When bare wire is called for, use the length of bare wire supplied with the kit.

( ) Prepare the following lengths of hookup wire.

1" bare	3-1/2" yellow
1-1/2" blue	4" green
3-1/2" yellow	2-1/2" brown
3" blue	3-1/2" orange
1" bare	4" red
3-1/2" orange	2-1/2" red
2-1/2" blue	

( ) Connect a 1" bare wire between lug 6 (S-1) and lug 3 (NS) of control AC.

( ) Connect a 1-1/2" blue wire between lug 1 (NS) and lug 3 (S-2) of the CRT socket.

( ) Connect the remaining prepared wires to control AF in the following steps.

( ) Connect one end of a 3-1/2" yellow wire to lug 1 (S-1). The other end will be connected later.

( ) Connect one end of a 3" blue wire to lug 3 (S-1). The other end will be connected later.

( ) Connect one end of a 1" bare wire to lug 4 (NS). Solder the other end of this wire to the side of the switch as shown. Cut off the excess wire length.

( ) Connect one end of a 3-1/2" orange wire to lug 4 (S-2). The other end will be connected later.

( ) Connect a 1-1/2" blue wire between lug 5 (S-1) and lug 15 (S-1).

( ) Connect one end of a 3-1/2" yellow wire to lug 6 (S-1). The other end will be connected later.

( ) Twist together the orange wire from lug 4 and the yellow wire from lug 6 of control AF.

( ) Connect one end of a 4" green wire to lug 7 (S-1). The other end will be connected later.

( ) Connect one end of a 2-1/2" brown wire to lug 9 (S-1). The other end will be connected later.

( ) Connect one end of a 3-1/2" orange wire to lug 10 (S-1). The other end will be connected later.

( ) Connect one end of a 4" red wire to lug 11 (S-1). Connect the other end of this wire to the circuit board hole marked RED (S-1).

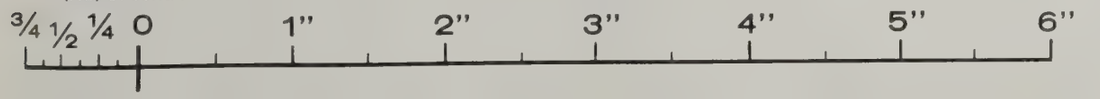
( ) Connect one end of a 2-1/2" red wire to lug 12 (S-1). The other end will be connected later.

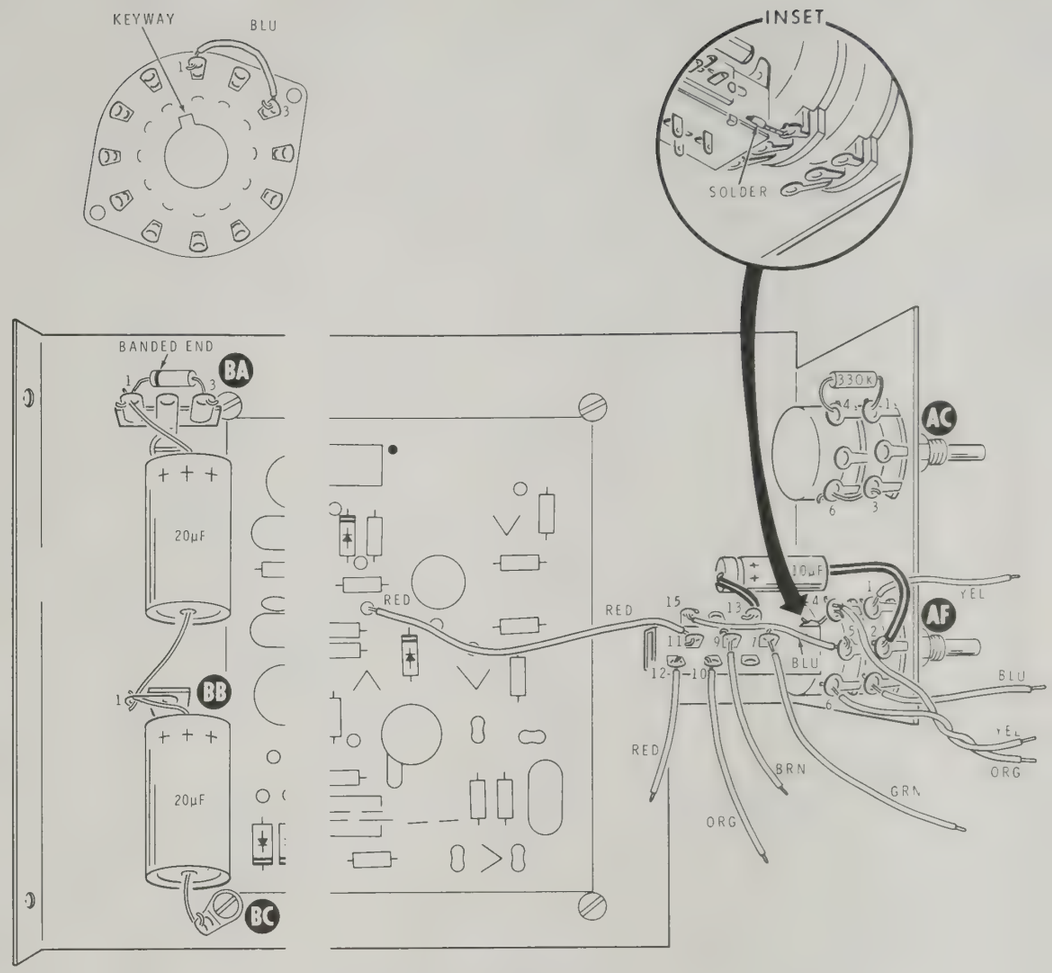
( ) Place a 3/4" length of sleeving on each lead of a 10 μF tubular electrolytic capacitor.

( ) Connect the positive (+) lead to lug 13 of control AF (S-1). Connect the other lead to lug 2 of control AF (S-1). Position this capacitor against the control as shown.

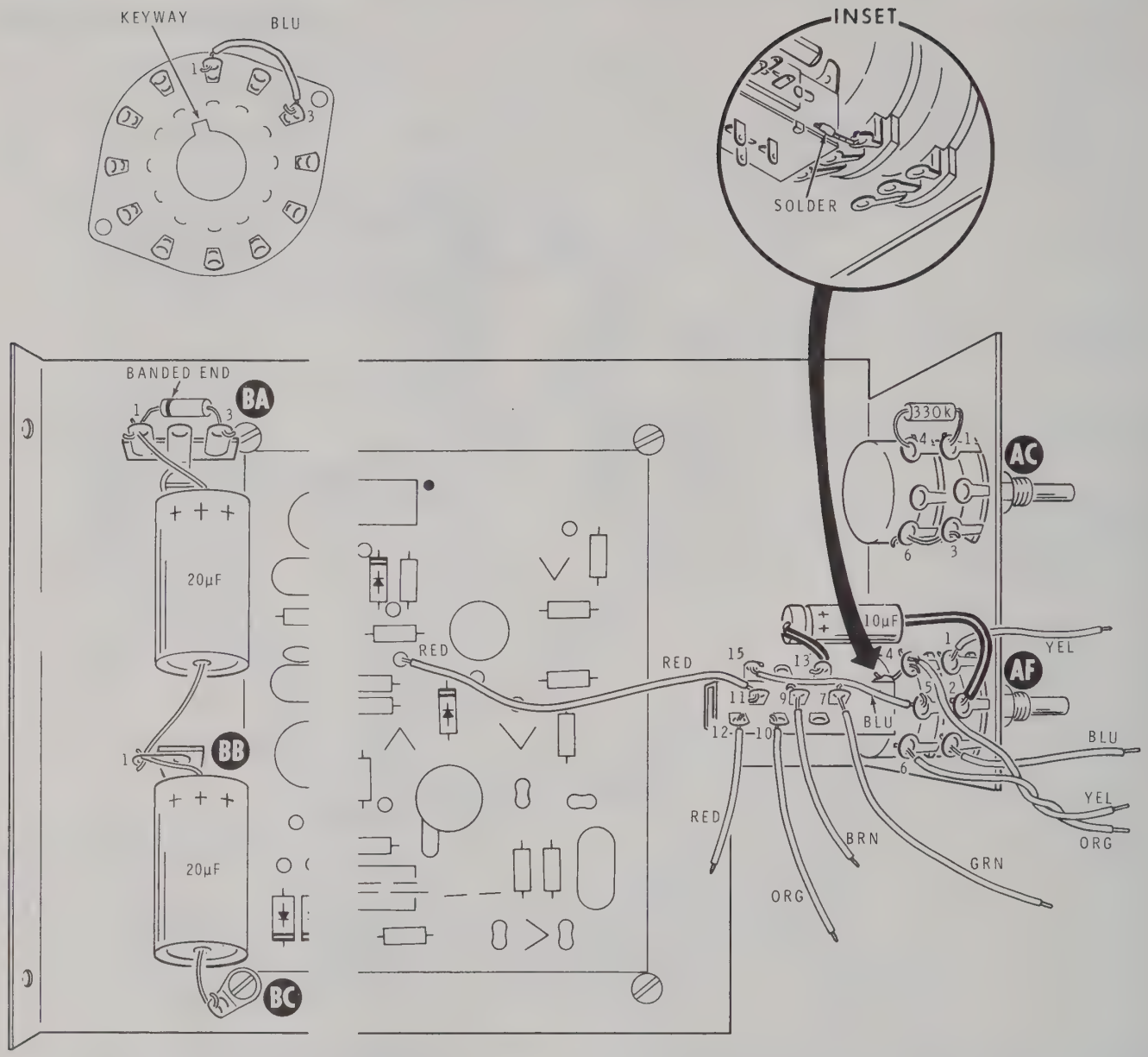
( ) Cut off any excess lead lengths that may extend from the foil side of the circuit board.

Set the side panel aside temporarily. Proceed to Page 18.

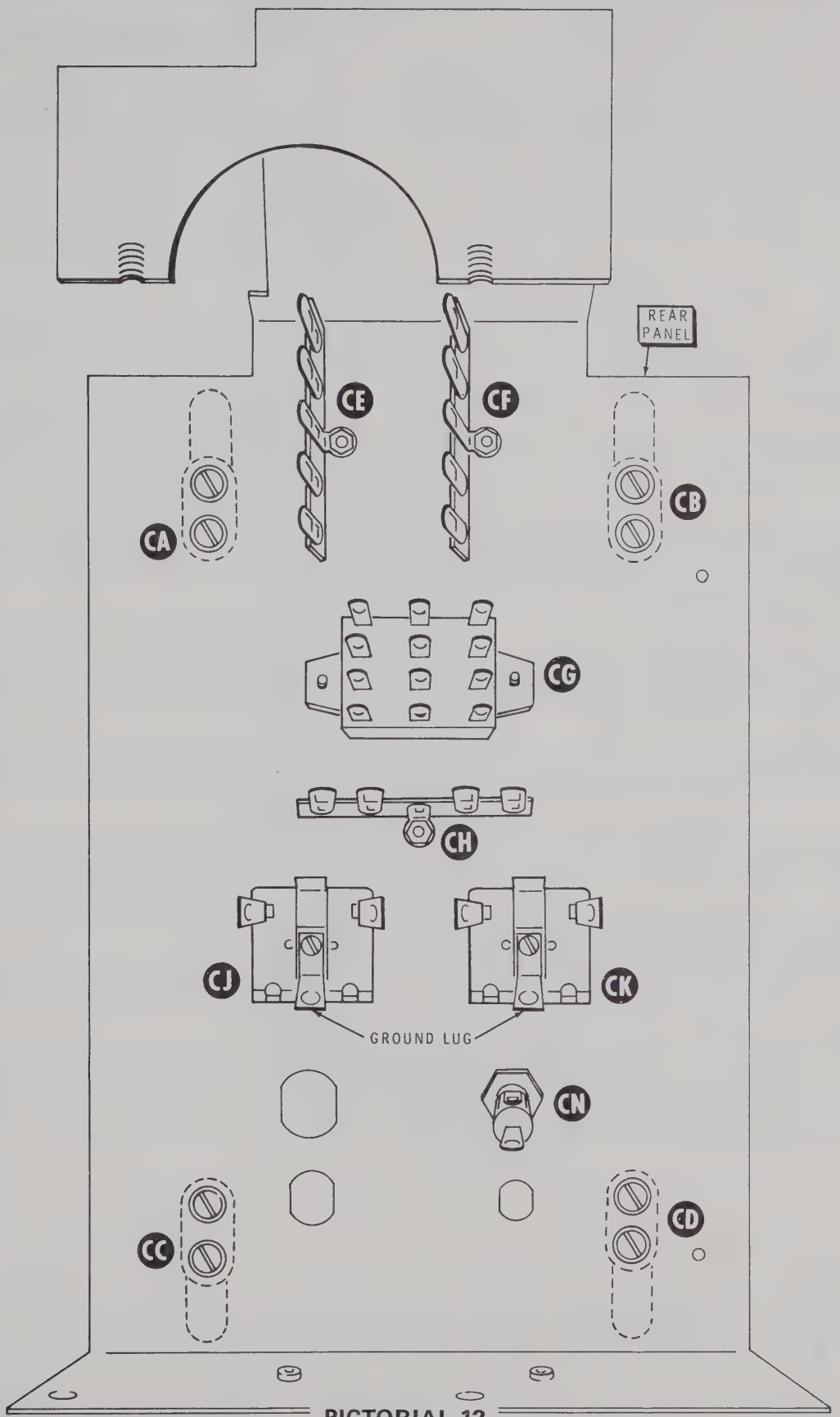




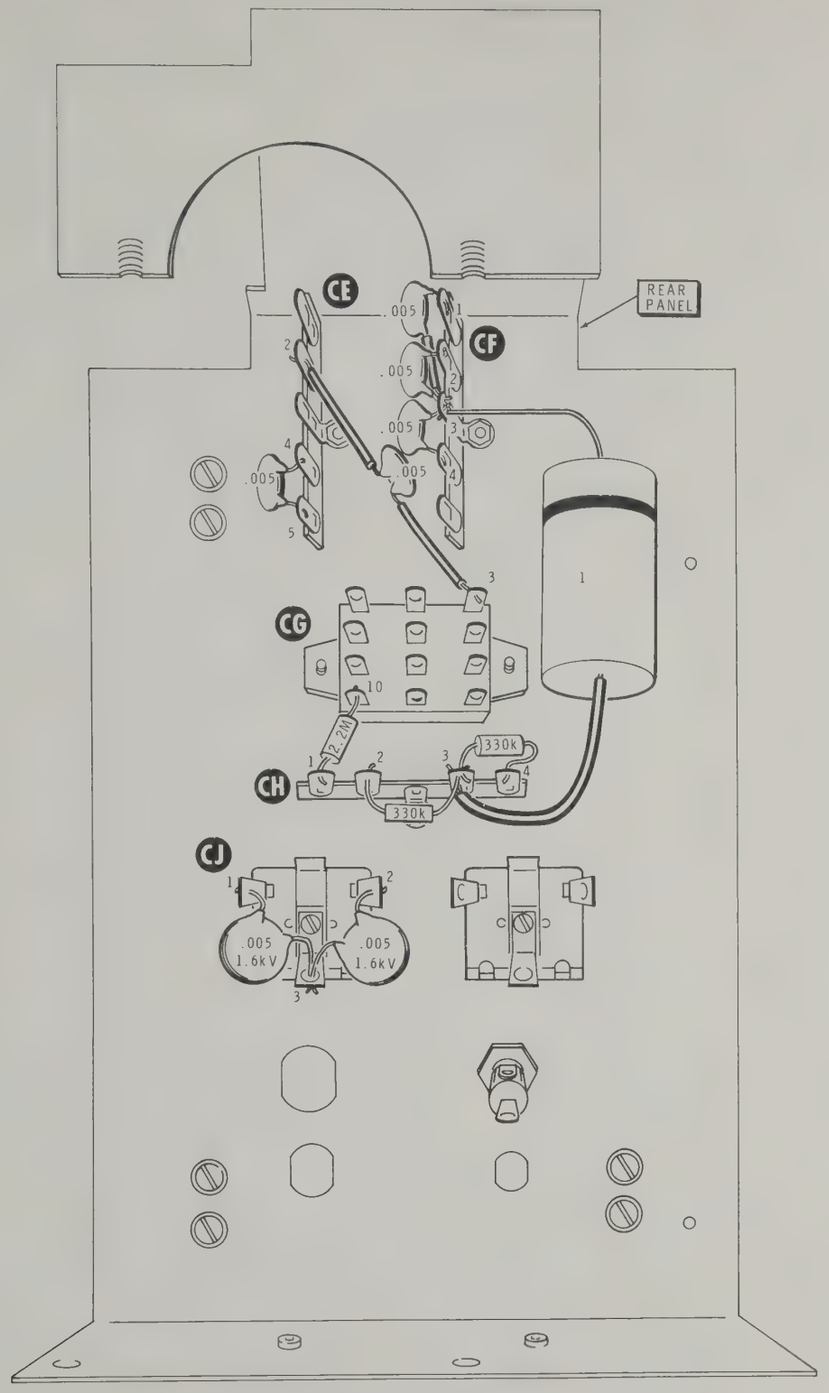
PICTORIAL 11



PICTORIAL 11



PICTORIAL 12



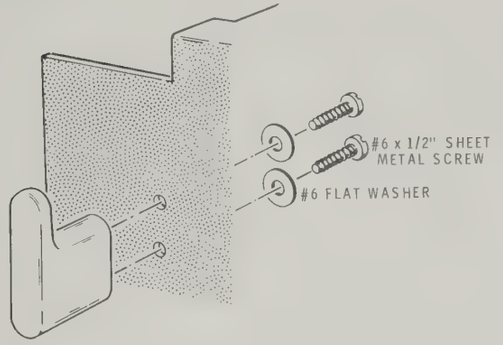
PICTORIAL 14

REAR PANEL PREPARATION

Refer to Pictorial 12 for the following steps.

( ) Locate the rear panel and position it as shown.

( ) Refer to Detail 12A and mount line cord retainers on the outside of the rear panel at locations CA, CB, CC, and CD. Use a #6 x 1/2" sheet metal screws and #6 flat washers. Be sure to position the retainers as shown by the dotted lines in the Pictorial.

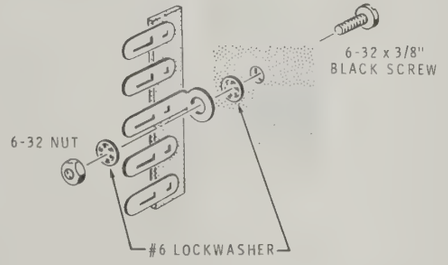


Detail 12A

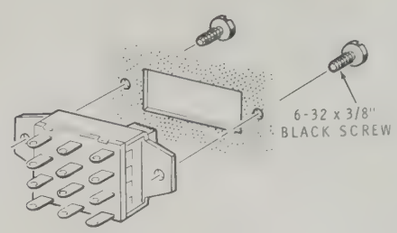
NOTE: Do not use the 6-32 x 3/8" black flat head screws until they are specifically called for in a step.

( ) Refer to Detail 12B and mount large 5-lug terminal strips at CE and CF. Use 6-32 x 3/8" black screws, #6 lockwashers, and 6-32 nuts. Position these terminal strips as shown in the Pictorial.

( ) Mount a 4-lug terminal strip at CH. Use a 6-32 x 3/8" black screw, #6 lockwashers, and a 6-32 nut.



Detail 12B

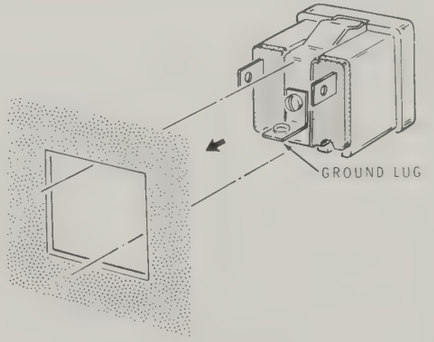


Detail 12C

( ) Refer to Detail 12C and install a 4PDT slide switch at CG. Use 6-32 x 3/8" black screws.

( ) Remove the green screw from the ground lug of both AC sockets.

( ) Refer to Detail 12D and install AC sockets at CJ and CK from the outside of the rear panel. Position each socket so the lugs are as shown in the Pictorial.

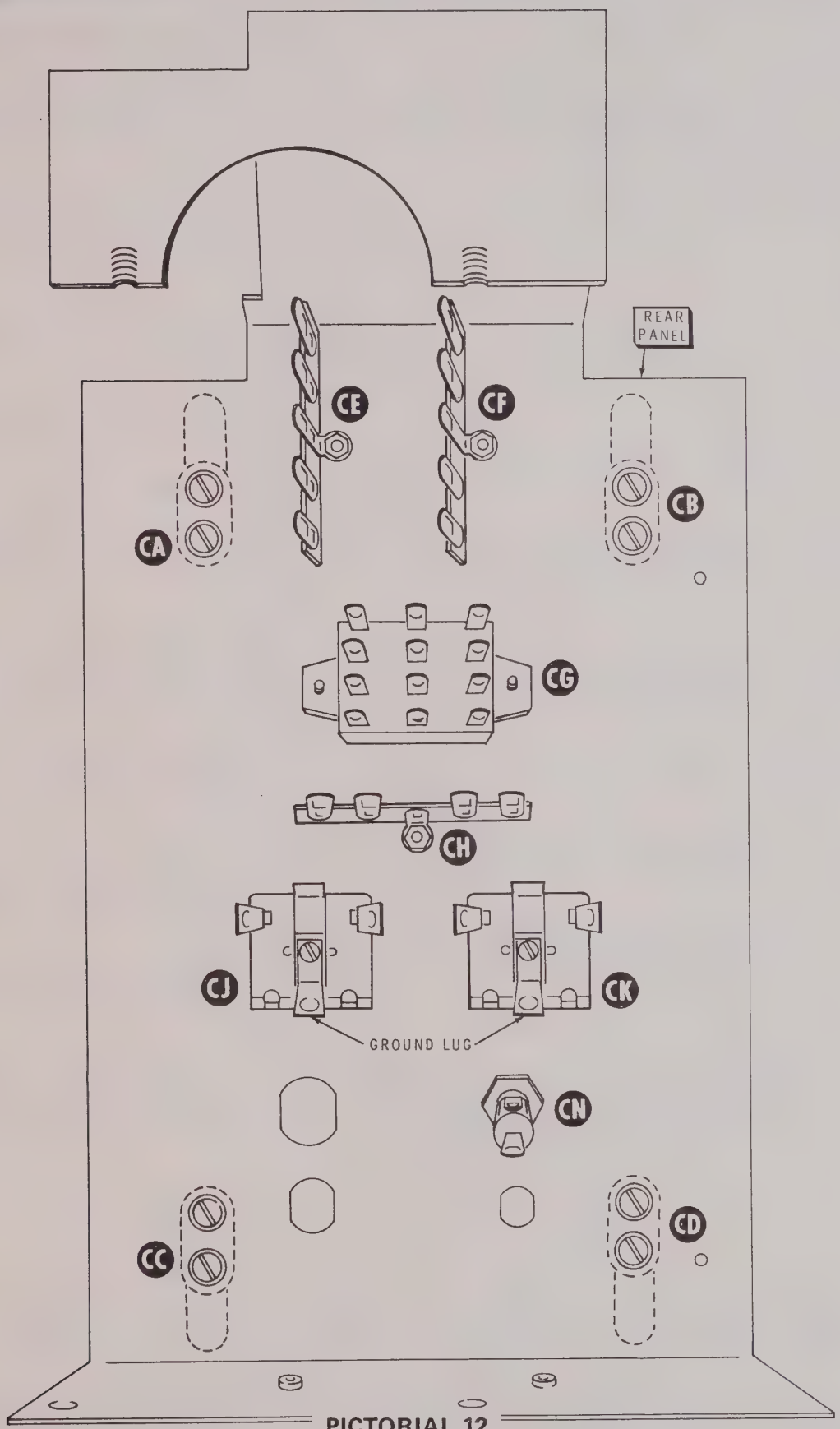


Detail 12D

( ) Refer to Detail 12E and mount the fuseholder at CN. Use the washers and nut supplied with the fuseholder. Position the lugs as shown.



Detail 12E



PICTORIAL 12

Refer to Pictorial 13 for the following steps.

NOTE: When hookup wire is called for in the following steps, use the length of blue wire previously cut from the wiring harness. When bare wire is called for, use the length of bare wire supplied with the kit.

( ) Prepare the following lengths of hookup wire:

2-3/4" 2"
3-1/4" 1" bare
3-1/4"

( ) Connect a 2-3/4" wire from lug 3 (NS) to lug 10 (NS) of switch CG.

( ) Connect a 3-1/4" wire between lug 7 (NS) and lug 6 (S-1) of switch CG.

NOTE: Where a wire passes through a connection and then goes to another point, as in the next step, it will count as two wires in the solder instructions (S-2), one entering and one leaving the connection.

( ) Remove an additional 1/8" of insulation from one end of a 3-1/4" wire. Connect this end through lug 1 (S-2) to lug 4 (S-1) of switch CG.

( ) Connect the other end of this wire to lug 3 of terminal strip CH (NS).

( ) Connect a 2" wire from lug 7 of switch CG (S-2) to lug 5 of terminal strip CE (NS).

( ) Insert one end of a 1" bare wire through lug 12 (S-2) to lug 9 (S-1) of switch CG. Connect the other end to lug 3 of terminal strip CH (NS).

( ) Prepare four 3" lengths of brown stranded wire.

( ) Twist the strands of wire at the end of each prepared wire; then melt a small amount of solder on the end of each, just enough to keep the wire strands together.

( ) Connect a 3" brown stranded wire from lug 1 of socket CJ (NS) to lug 1 of socket CK (NS).

( ) Connect a 3" brown stranded wire from lug 2 of socket CJ (NS) to lug 2 of socket CK (NS).

NOTE: When soldering to lug 3 of the AC sockets, as in the following step, a larger soldering iron may be required to supply the additional heat needed to obtain a good connection.

( ) Connect a 3" brown stranded wire from lug 3 of socket CJ (NS) to lug 3 of socket CK (S-1).

( ) Connect a 3" brown stranded wire from lug 1 of socket CK (S-2) to lug 1 of fuseholder CN (S-1).

( ) Prepare a 4" length of brown stranded wire.

( ) Connect one end of the 4" brown stranded wire to lug 2 of socket CK (S-2). The other end will be connected later.

( ) Locate the three 100 kΩ 1 watt (brown-black-yellow) resistors and cut the leads of each resistor to a length of 1/2".

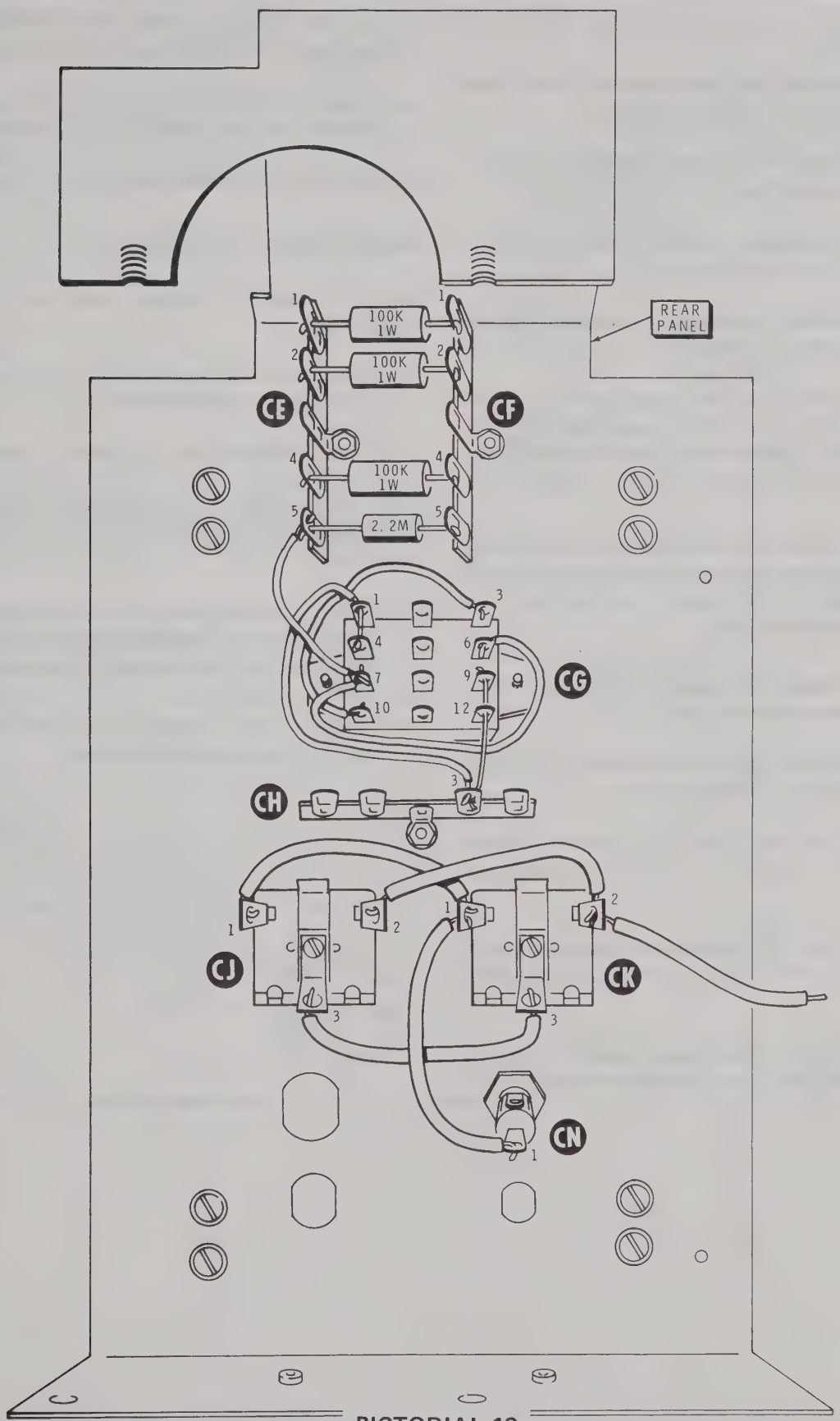
( ) Connect a 100 kΩ 1 watt resistor from lug 1 of terminal strip CE (NS) to lug 1 of terminal strip CF (NS).

( ) Connect a 100 kΩ 1 watt resistor from lug 2 of terminal strip CE (NS) to lug 2 of terminal strip CF (NS).

( ) Connect a 100 kΩ 1 watt resistor from lug 4 of terminal strip CE (NS) to lug 4 of terminal strip CF (NS).

( ) Connect a 2.2 MΩ (red-red-green) resistor from lug 5 of terminal strip CE (NS) to lug 5 of terminal strip CF (NS).





PICTORIAL 13

Refer to Pictorial 14 (fold-out from Page 18) for the following steps.

NOTE: In the following steps, do not use the .005 μF 1600 V disc capacitors unless specifically called for.

(✓) Place a 3/4" length of small sleeving on each lead of a .005 μF disc capacitor.

(✓) Connect this capacitor from lug 2 of terminal strip CE (NS) to lug 3 of switch CG (S-2).

(✓) Connect a .005 μF disc capacitor from lug 4 (NS) to lug 5 (S-3) of terminal strip CE.

(✓) Connect the lead from the banded end of a .1 μF tubular capacitor to lug 3 of terminal strip CF (NS). Place a 1-1/4" length of small sleeving on the other lead; then connect this lead to lug 3 of terminal strip CH (NS).

(✓) Place a 3/4" length of small sleeving on one lead of a .005 μF disc capacitor. Connect this lead to lug 3 of terminal strip CF (NS). Connect the other lead to lug 1 of terminal strip CF (NS).

(✓) Connect a .005 μF disc capacitor between lug 2 (NS) and lug 3 (NS) of terminal strip CF.

(✓) Connect a .005 μF disc capacitor between lug 4 (NS) and lug 3 (S-4) of terminal strip CF.

(✓) Connect a 330 kΩ (orange-orange-yellow) resistor between lug 2 (NS) and lug 3 (NS) of terminal strip CH.

(✓) Connect a 330 kΩ (orange-orange-yellow) resistor between lug 3 (S-5) and lug 4 (NS) of terminal strip CH.

(✓) Connect a 2.2 MΩ (red-red-green) resistor from lug 10 of switch CG (S-2) to lug 1 of terminal strip CH (NS).

(✓) Connect a .005 μF 1600 V (1.6 kV) disc capacitor between lug 1 (NS) and lug 3 (NS) of socket CJ.

(✓) Connect a .005 μF 1600 V (1.6 kV) disc capacitor between lug 2 (NS) and lug 3 (NS) of socket CJ.

Set the rear panel assembly aside until it is called for later.

FRONT PANEL PREPARATION

Refer to Pictorial 15 (fold-out from Page 25) for the following steps.

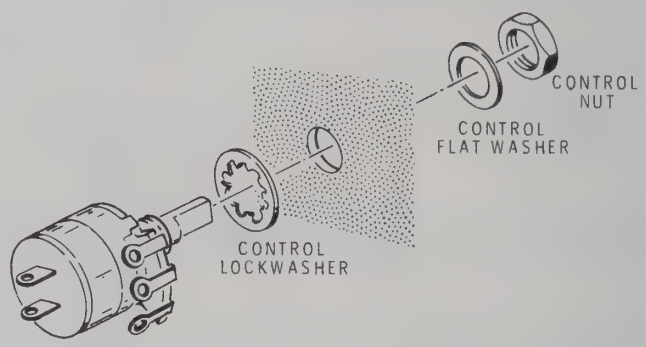
(✓) Place a cloth on your work surface to protect the front panel in the following steps.

(✓) Locate the front panel and position it as shown.

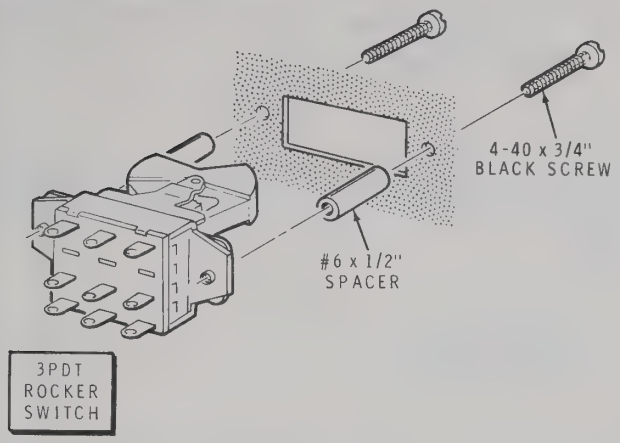
NOTE: The location of the switch lugs at the rear of the following two switches may be different than that shown on the Pictorial.

(✓) Refer to Detail 15A and install a 250 kΩ control (#19-149) at AA. Use a control lockwasher, a control flat washer, and a control nut. Position the control as shown.

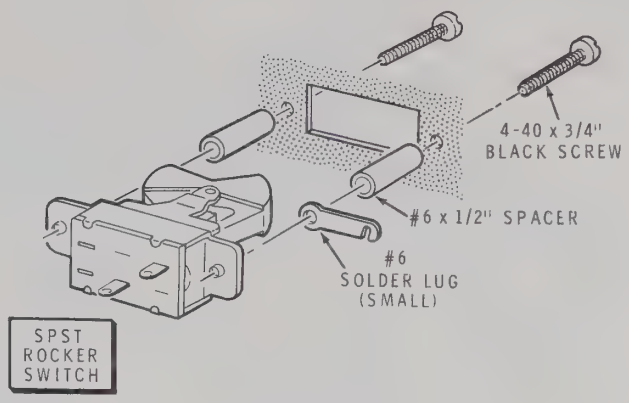
(✓) Similarly, install a 2000 Ω (2k) control (#19-148) at AD. Position the control as shown.



Detail 15A



Detail 15B



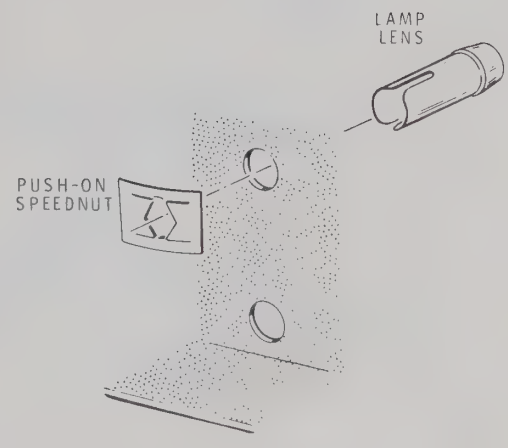
Detail 15C

(✓) Refer to Detail 15B and install a 3PDT rocker switch at AE. Position the wide space between the lug rows as shown. Use 4-40 x 3/4" black screws and #6 x 1/2" spacers.

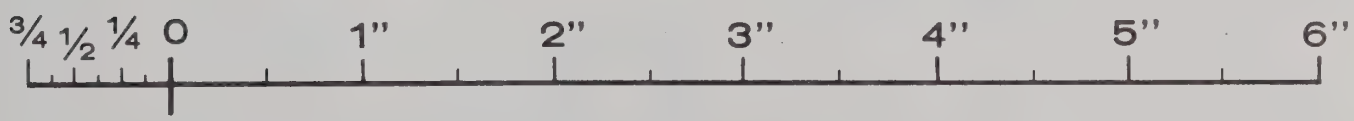
(✓) Refer to Detail 15C and install SPST rocker switches at AG, AH, and AJ. Be sure to position the switch lugs and solder lug as shown. Use two 4-40 x 3/4" black screws, two #6 x 1/2" spacers, and a small #6 solder lug on each switch.

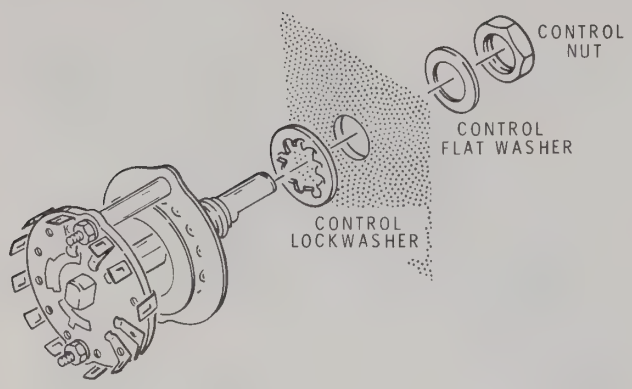
(✓) Bend each solder lug as shown in the Pictorial.

(✓) Refer to Detail 15D and install the lamp lens at AK with a push-on speednut. Use a screwdriver to push the speednut tightly against the inside of the front panel. Position the slots in the lamp lens as shown in the Pictorial.



Detail 15D

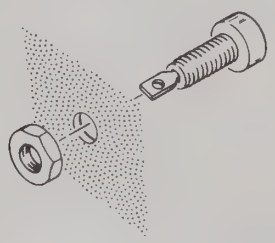




Detail 15E

( ) Refer to Detail 15E and install the rotary switch at AN. Position the two long lugs as shown in the Pictorial. Use a control lockwasher, a control flat washer, and a control nut.

( ) Refer to Detail 15F and install the white banana jack at AP. Use the nut supplied with the banana jack.



Detail 15F

Refer to Pictorial 16 for the following steps.

( ) Prepare the following lengths of bare wire:

1"
2"
1"

( ) Connect a 1" bare wire from lug 1 (S-1) to solder lug 3 (S-1) of switch AG.

( ) Connect a 2" bare wire from lug 1 of control AD (S-1), through solder lug 3 (S-2), to lug 1 (S-1) of switch AH.

( ) Connect a 1" bare wire between lug 1 (S-1) and solder lug 3 (NS) of switch AJ.

Refer to Detail 16A for the following five steps. The Detail is divided into parts, and each step will refer to the pertinent part.

( ) Refer to Part 1 and cut the leads of the neon lamp to a length of 1/2".

( ) Refer to Part 2 and insert the lamp as far as it will go into the lens.

( ) Position the terminal collar as shown in the Pictorial, and push the collar onto the lens until the ends of the collar and the lens are flush with each other as shown in Part 3.

( ) Refer to Part 4 and connect one lamp lead to lug 2 (NS) and the other lamp lead to lug 3 (NS) of the terminal collar.

( ) Refer to Part 5 and connect a 33 kΩ (orange-orange-orange) resistor between lug 1 (NS) and lug 2 (S-2) of the terminal collar. Cut off any excess lead lengths.

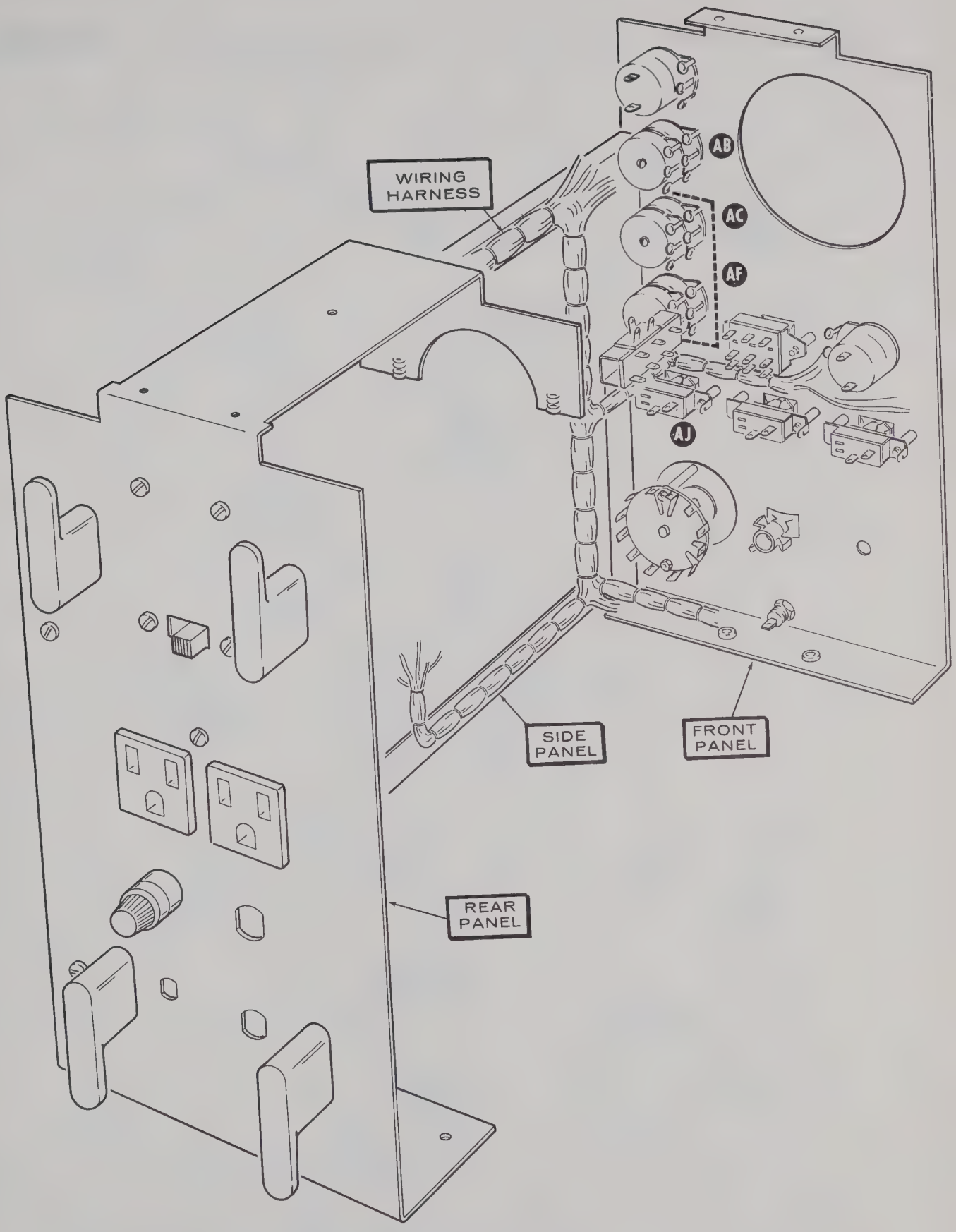
( ) Cut each lead of a 5600 Ω (green-blue-red) resistor to a length of 3/4".

( ) Place a 1/2" length of sleeving on each lead of this resistor.

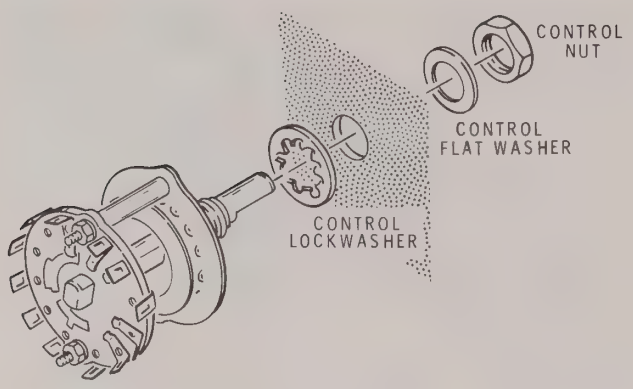
( ) Connect this resistor between lug 12 (NS) and lug 7 (S-1) of rotary switch AN. Be sure the resistor leads do not touch any of the other lugs.

( ) Connect a 200 pF mica capacitor from lug 12 of switch AN (NS) to solder lug 3 of switch AJ (S-2).





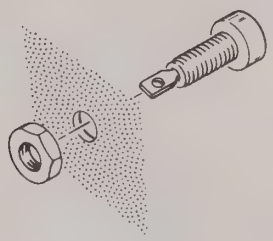
PICTORIAL 17



Detail 15E

( ) Refer to Detail 15E and install the rotary switch at AN. Position the two long lugs as shown in the Pictorial. Use a control lockwasher, a control flat washer, and a control nut.

( ) Refer to Detail 15F and install the white banana jack at AP. Use the nut supplied with the banana jack.



Detail 15F

Refer to Pictorial 16 for the following steps.

( ) Prepare the following lengths of bare wire:

1"
2"
1"

( ) Connect a 1" bare wire from lug 1 (S-1) to solder lug 3 (S-1) of switch AG.

( ) Connect a 2" bare wire from lug 1 of control AD (S-1), through solder lug 3 (S-2), to lug 1 (S-1) of switch AH.

( ) Connect a 1" bare wire between lug 1 (S-1) and solder lug 3 (NS) of switch AJ.

Refer to Detail 16A for the following five steps. The Detail is divided into parts, and each step will refer to the pertinent part.

( ) Refer to Part 1 and cut the leads of the neon lamp to a length of 1/2".

( ) Refer to Part 2 and insert the lamp as far as it will go into the lens.

( ) Position the terminal collar as shown in the Pictorial, and push the collar onto the lens until the ends of the collar and the lens are flush with each other as shown in Part 3.

( ) Refer to Part 4 and connect one lamp lead to lug 2 (NS) and the other lamp lead to lug 3 (NS) of the terminal collar.

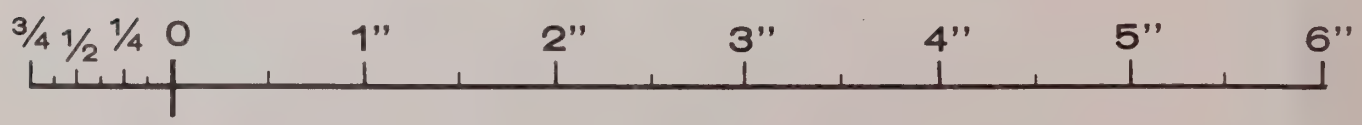
( ) Refer to Part 5 and connect a 33 kΩ (orange-orange-orange) resistor between lug 1 (NS) and lug 2 (S-2) of the terminal collar. Cut off any excess lead lengths.

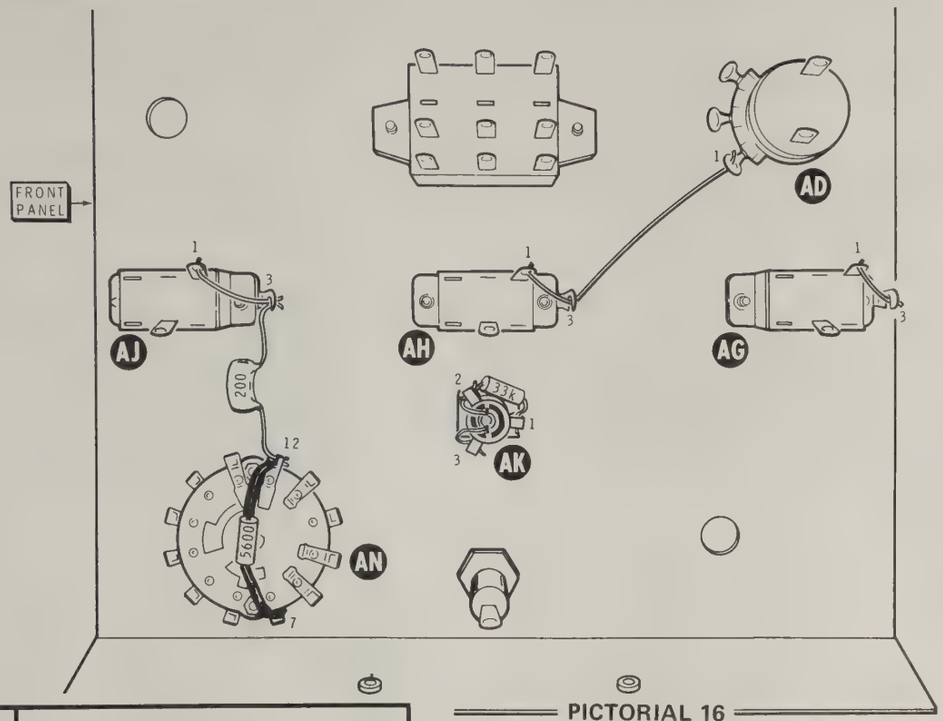
( ) Cut each lead of a 5600 Ω (green-blue-red) resistor to a length of 3/4".

( ) Place a 1/2" length of sleeving on each lead of this resistor.

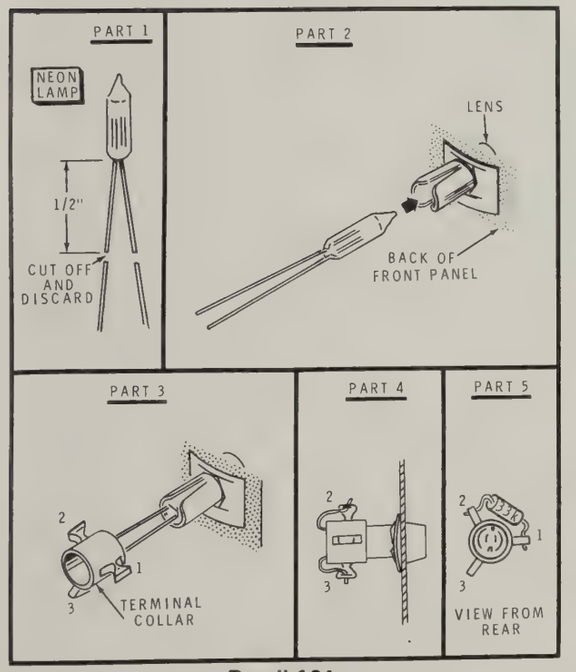
( ) Connect this resistor between lug 12 (NS) and lug 7 (S-1) of rotary switch AN. Be sure the resistor leads do not touch any of the other lugs.

( ) Connect a 200 pF mica capacitor from lug 12 of switch AN (NS) to solder lug 3 of switch AJ (S-2).

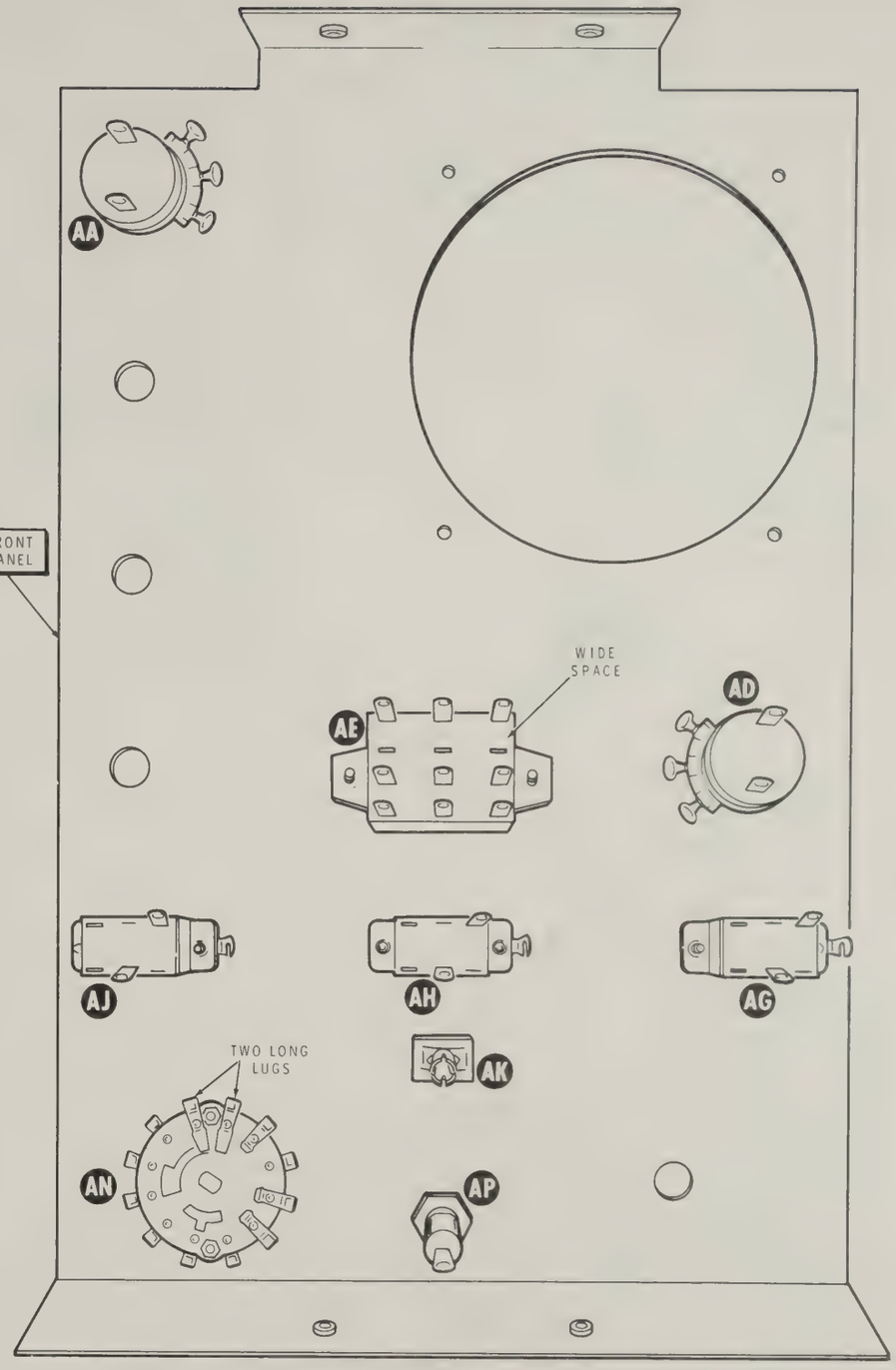




PICTORIAL 16



Detail 16A



PICTORIAL 15

CHASSIS ASSEMBLY

Refer to Pictorial 17 for the following steps.

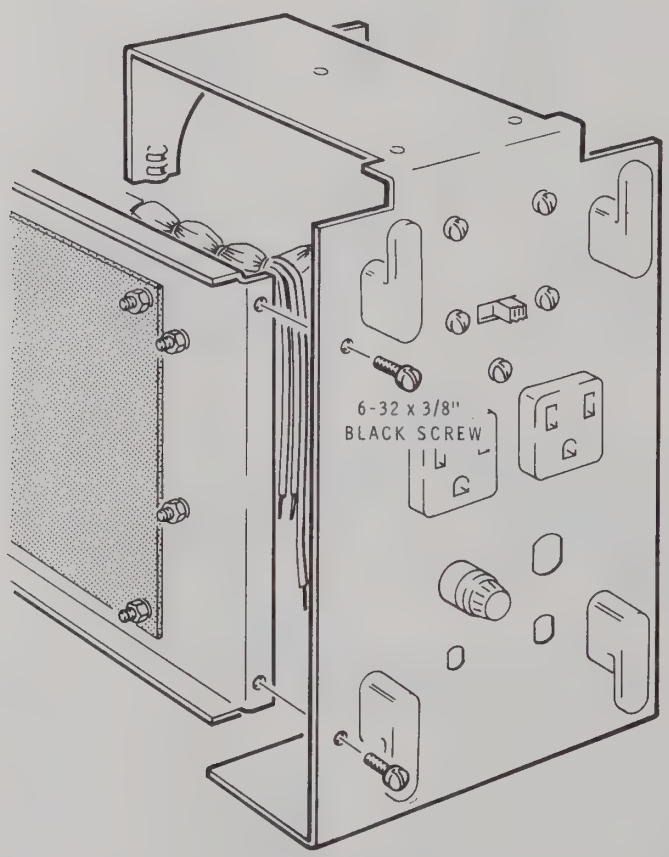
(✓) Remove the control nuts and control flat washers from controls AC and AF on the side panel. Do not remove the controls.

(✓) Refer to Detail 17A and install the front panel on the side panel. Align controls AC and AF with their respective holes in the front panel. Then replace the control flat washers and control nuts. Be careful not to pinch any wires between the front panel and the side panel.

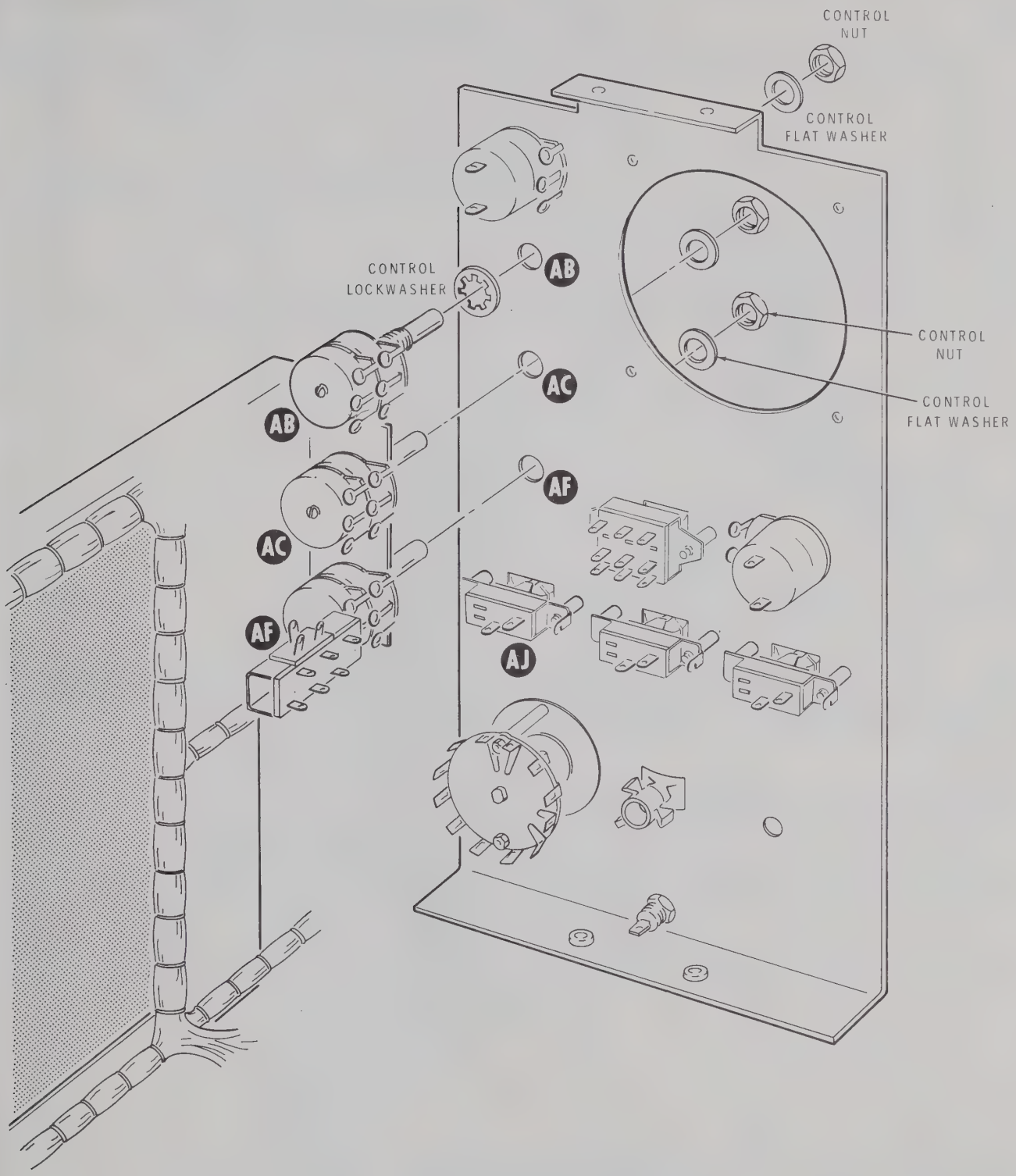
(✓) Position the wiring harness against the side panel and front panel between control AF and switch AJ as shown in the Pictorial. It may be necessary to loosen control AF and AJ to allow the wiring harness to pass between the controls.

(✓) Install a 500 kΩ/500 kΩ control (#12-105) at AB. Use a control lockwasher, a control flat washer, and a control nut. Position the lugs of the control as shown in Pictorial 17.

(✓) Refer to Detail 17B and mount the rear panel on the side panel. Use two 6-32 x 3/8" black screws. Be careful not to pinch any wires between the side panel and rear panel. Route the black stranded, red stranded, and brown stranded wires from BO#2 against the rear panel (in back of the 20 μF electrolytic capacitors) before tightening the rear panel screws.



Detail 17B


CONTROL NUT
CONTROL FLAT WASHER
CONTROL LOCKWASHER
AB
AC
AF
AJ
CONTROL NUT
CONTROL FLAT WASHER

Detail 17A

Refer to Pictorial 18 (fold-out from page) for the following steps.

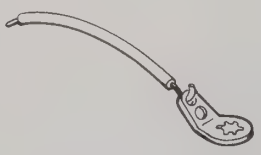
( ) Prepare the following lengths of hookup wire:

2-1/4"
2-1/4"
2"
1" bare

( ) Connect a 2-1/4" wire between lug 3 of control AC (S-2) and lug 3 of control AB (NS).

( ) Connect a 2-1/4" wire between lug 1 of control AC (S-2) and lug 1 of control AB (NS).

( ) Refer to Detail 18A and connect one end of a 2" wire to a large #6 solder lug (S-1).



Detail 18A

( ) Connect the other end of this wire to lug 4 of control AB (NS). The solder lug will be connected to the front panel later.

( ) Connect a 1" bare wire between lug 4 of control AC (S-2) and lug 6 of control AB (S-1).

( ) Place a 1/2" length of small sleeving on one lead of a 220 kΩ (red-red-yellow) resistor.

( ) Connect this lead to lug 1 of control AA (NS). Connect the other lead to lug 4 of control AB (S-2).

( ) Place a 3/4" length of small sleeving on each lead of a 2.2 MΩ (red-red-green) resistor.

( ) Connect this resistor between lug 1 of control AA (S-2) and lug 3 of control AB (NS).

Connect the wires from BO#6 to control AB as follows:

( ) White-green to lug 5 (S-1).

( ) White-yellow to lug 1 (S-2).

( ) White-black to lug 2 (S-1).

( ) White-gray to lug 3 (S-3).

Connect the remaining wire from BO#6 to control AA as follows:

( ) Green to lug 3 (S-1).

( ) White-brown to lug 2 (S-1).

NOTE: Inset drawing #1 shows an alternate location of the lugs at the rear of control AA. Use the drawing that most closely resembles your particular control.

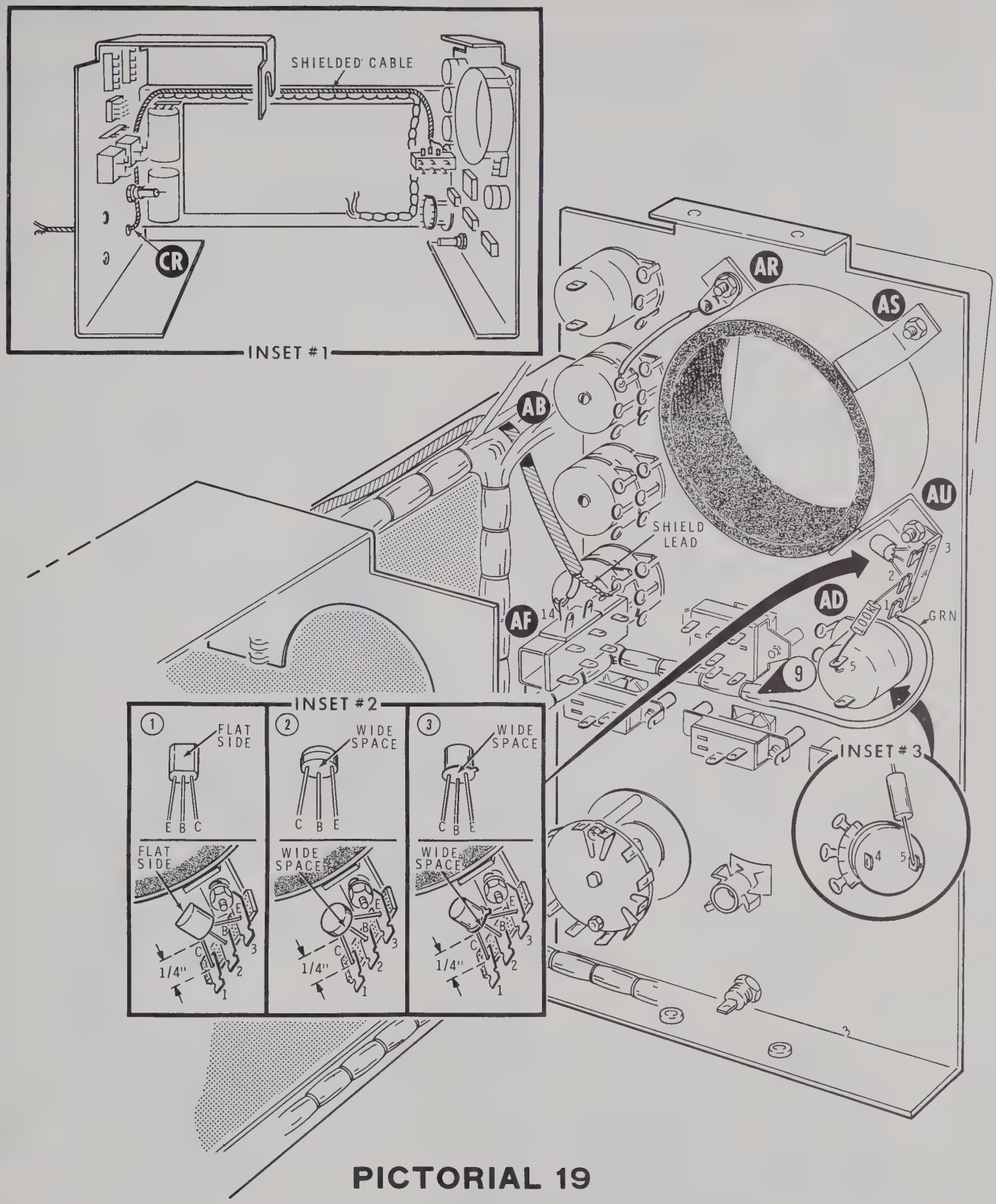
( ) Both brown stranded to lug 4 (S-2).

( ) Red stranded to lug 5 (S-1).

( ) Connect the green wire from BO#7 to lug 2 of switch AJ (S-1).

( ) Connect the blue wire from BO#8 to lug 2 of switch AH (S-1).





PICTORIAL 19

Refer to Pictorial 18 (fold-out from page) for the following steps.

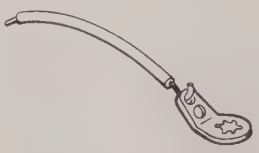
( ) Prepare the following lengths of hookup wire:

2-1/4"
2-1/4"
2"
1" bare

( ) Connect a 2-1/4" wire between lug 3 of control AC (S-2) and lug 3 of control AB (NS).

( ) Connect a 2-1/4" wire between lug 1 of control AC (S-2) and lug 1 of control AB (NS).

( ) Refer to Detail 18A and connect one end of a 2" wire to a large #6 solder lug (S-1).



Detail 18A

( ) Connect the other end of this wire to lug 4 of control AB (NS). The solder lug will be connected to the front panel later.

( ) Connect a 1" bare wire between lug 4 of control AC (S-2) and lug 6 of control AB (S-1).

( ) Place a 1/2" length of small sleeving on one lead of a 220 kΩ (red-red-yellow) resistor.

( ) Connect this lead to lug 1 of control AA (NS). Connect the other lead to lug 4 of control AB (S-2).

( ) Place a 3/4" length of small sleeving on each lead of a 2.2 MΩ (red-red-green) resistor.

( ) Connect this resistor between lug 1 of control AA (S-2) and lug 3 of control AB (NS).

Connect the wires from BO#6 to control AB as follows:

( ) White-green to lug 5 (S-1).

( ) White-yellow to lug 1 (S-2).

( ) White-black to lug 2 (S-1).

( ) White-gray to lug 3 (S-3).

Connect the remaining wire from BO#6 to control AA as follows:

( ) Green to lug 3 (S-1).

( ) White-brown to lug 2 (S-1).

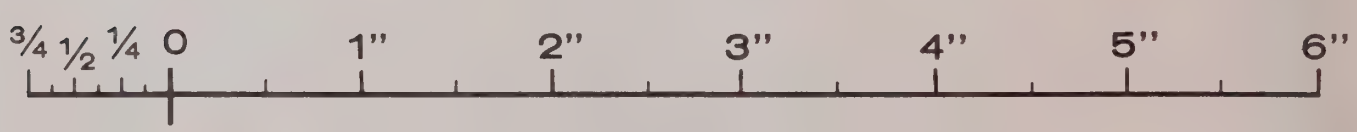
NOTE: Inset drawing #1 shows an alternate location of the lugs at the rear of control AA. Use the drawing that most closely resembles your particular control.

( ) Both brown stranded to lug 4 (S-2).

( ) Red stranded to lug 5 (S-1).

( ) Connect the green wire from BO#7 to lug 2 of switch AJ (S-1).

( ) Connect the blue wire from BO#8 to lug 2 of switch AH (S-1).



( ) Refer to inset drawing #2 of Pictorial 18 and cut off lug 6 of switch AE.

Connect the wires from BO#8 to switch AE as follows:

( ) Orange to lug 1 (S-1).
( ) White-yellow to lug 4 (S-1).
( ) Yellow to lug 7 (S-1).
( ) White-gray to lug 2 (S-1).
( ) White-orange to lug 5 (S-1).
( ) White to lug 8 (S-1).
( ) Remove an additional 1/2" of insulation from the end of the gray wire.
( ) Connect this wire through lug 9 (S-2) to lug 3 (S-1).

Connect the wires from BO#9 as follows:

( ) Red to lug 2 of switch AG (S-1).
( ) Gray to lug 2 of control AD (S-1).
( ) Orange to lug 3 of control AD (S-1).

NOTE: Inset drawing #3 shows an alternate location of the lugs at the rear of control AD. Use the drawing that most closely resembles your particular control.

( ) Violet to lug 4 of control AD (S-1).
( ) Both white-blue to lug 5 of switch AD (NS).

The green wire will be connected later.

Connect the wires from BO#10 to switch AN as follows:

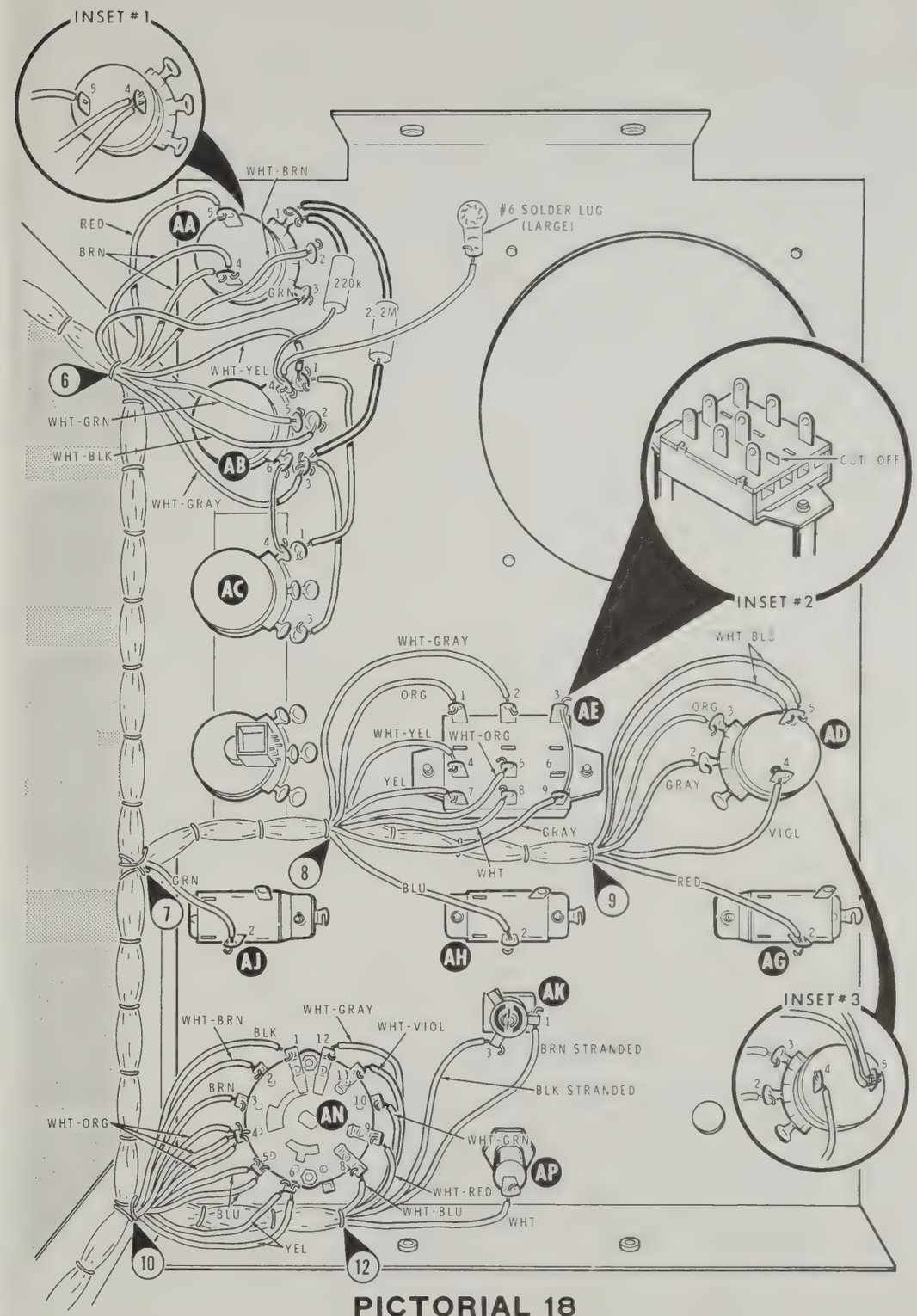
( ) Black to lug 1 (S-1).
( ) White-brown to lug 2 (S-1).
( ) Brown to lug 3 (S-1).
( ) Three white-orange to lug 4 (S-3).
( ) Both blue to lug 5 (S-2).
( ) Both yellow to lug 6 (S-2).

Connect the wires from BO#12 to switch AN as follows:

( ) White-blue to lug 8 (S-1).
( ) White-red to lug 9 (S-1).
( ) White-green to lug 10 (S-1).
( ) White-violet to lug 11 (S-1).
( ) White-gray to lug 12 (S-3).
( ) Position the wires against the front panel.

Connect the remaining wires from BO#12 as follows:

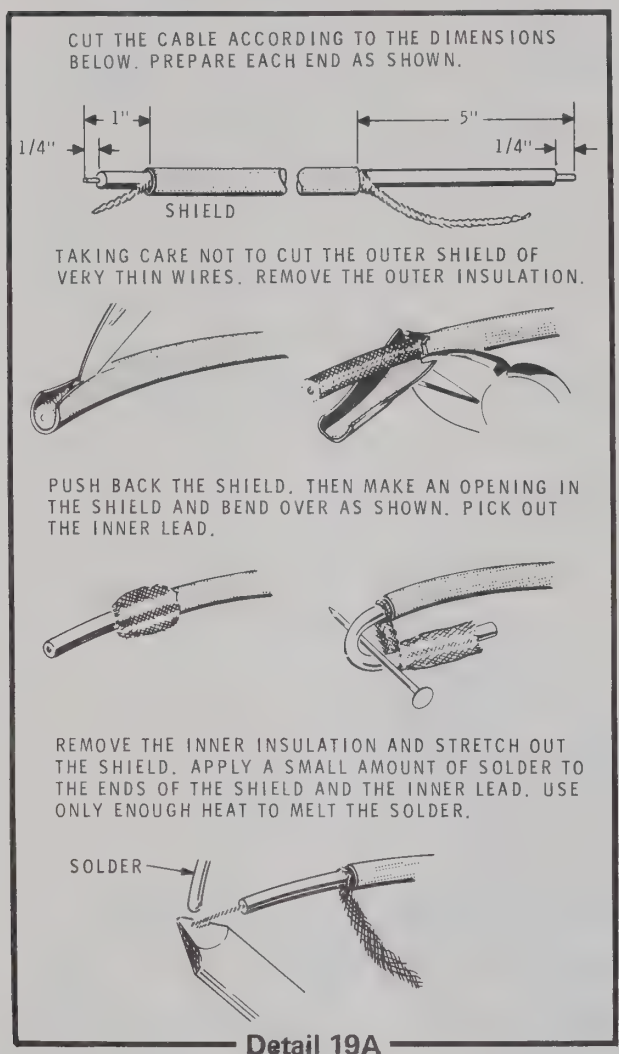
( ) White to lug of banana jack AP (S-1).
( ) Black stranded to lug 3 of lamp AK (S-2).
( ) Brown stranded to lug 1 of lamp AK (S-2).



PICTORIAL 18

Refer to Pictorial 19 for the following steps.

( ) Refer to Detail 19A and prepare both ends of the shielded cable.



Detail 19A

(✓) Route the 1" prepared end of the cable through hole CR in the rear panel and along the side panel as shown in inset drawing #1.

(✓) Connect the inner lead of the shielded cable to lug 14 of control AF (S-1).

(✓) Place the shield lead against the side of switch AF and over the bare wire previously soldered to the side of the switch. Then solder the shield lead to the switch. Be sure the shield lead does not touch any of the switch lugs.

Refer to Detail 19B for the following steps.

(✓) Locate the following parts: graticule, bezel, CRT ring, small 5-lug terminal strip, four 6-32 x 1/2" black screws, four #6 lockwashers, and four 6-32 nuts.

(✓) Remove the backing paper, if any, from the graticule.

(✓) Mount the graticule, bezel, and CRT ring on the front panel. Use the 6-32 x 1/2" hardware at AS and AT. Be sure to position the graticule lettering and bezel flange as shown in the Detail.

(✓) Use the solder lug extending from control AB at location AR.

(✓) Refer to the inset drawing of Detail 19B and cut off the two indicated lugs of the small 5-lug terminal strip.

(✓) Mount this terminal strip at AU. Use a 6-32 x 1/2" black screw, two #6 lockwashers, and a 6-32 nut.

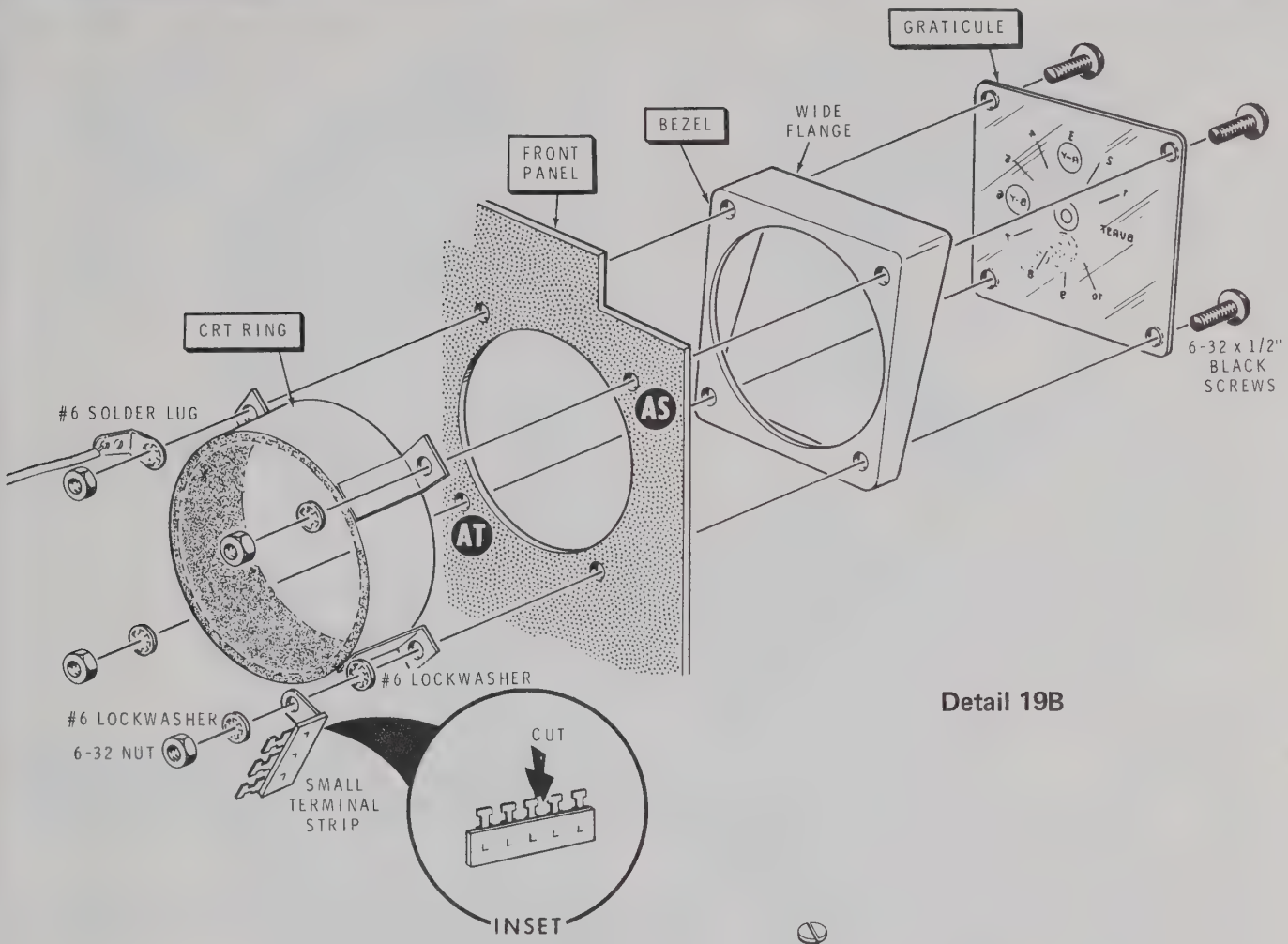
(✓) Install a #417-173 NPN transistor on terminal strip AU as follows: Locate the identification drawing in inset drawing #2 of Pictorial 19 that corresponds to the particular transistor you have received. Position the flat side (or wide space) as shown.

(✓) Then insert the leads (C, B, E) into the holes of lugs 1, 2, and 3 of the terminal strip. Position the transistor approximately 1/4" away from the terminal strip, solder the leads in the holes, and cut off the excess lead lengths.

(✓) Connect the green wire from BO#9 to lug 1 of terminal strip AU (S-1).

(✓) Connect a 100 kΩ (brown-black-yellow) resistor from lug 5 of control AD (S-3) to lug 2 of terminal strip AU (S-1). Position this resistor so the leads do not touch any other lugs. Inset drawing #3 of Pictorial 19 shows an alternate location of the lugs at the rear of control AD.





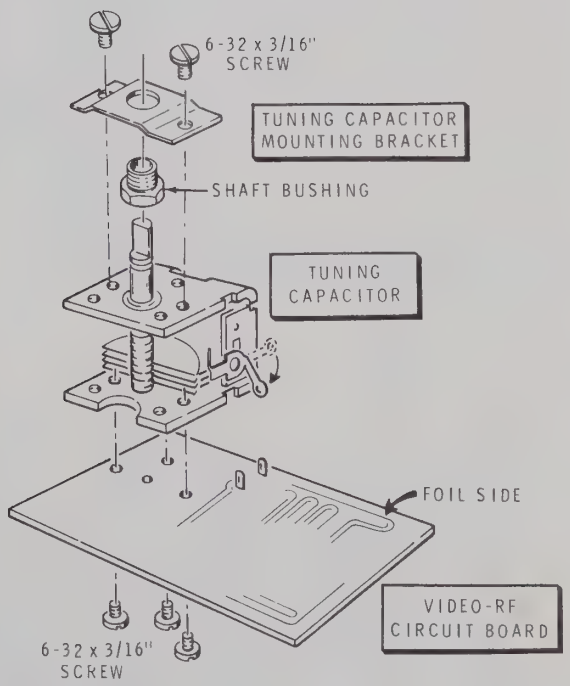
Detail 19B

Refer to Detail 20A for the next two steps.

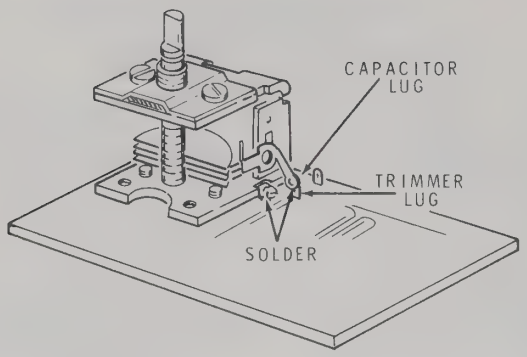
NOTE: Keep the plates of the tuning capacitor fully meshed while performing the following steps.

(✓) Insert the shaft bushing through the tuning capacitor mounting bracket. Then mount the tuning capacitor mounting bracket to the tuning capacitor with two 6-32 x 3/16" screws.

(✓) Mount the video-RF circuit board, foil side, to the tuning capacitor with three 6-32 x 3/16" screws as shown. Bend the tuning capacitor lug as shown.



Detail 20A



Detail 20B

Refer to Detail 20B for the next two steps.

( ) Solder the tuning capacitor lug to the trimmer lug.

( ) Solder the frame of the tuning capacitor to the foil on the circuit board.

Refer to Pictorial 20 for the following steps.

NOTE: In the following steps, cut off the excess wire lengths as each wire is soldered to the circuit board foil.

Connect the free ends of the twisted pair of wires from control AF to the video-RF circuit board as follows:

( ) Orange to ORG (S-1).

( ) Yellow to YEL (S-1).

Connect the remaining wires extending from control AF to the video-RF circuit board as follows:

( ) Red to RED (S-1).

( ) Brown to BRN (S-1).

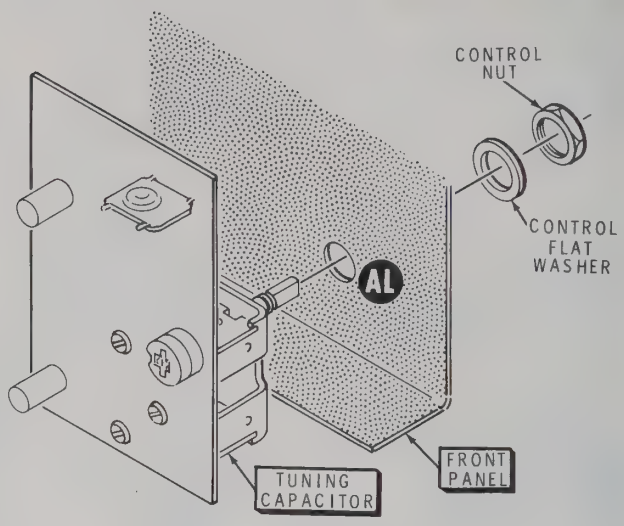
( ) Blue to BLU (S-1).

( ) Yellow to YEL (S-1).

( ) Orange to ORG (S-1).

( ) Green to GRN (S-1).

( ) Check to see that all connections are soldered, and cut off the excess lead lengths.



Detail 20C

( ) Refer to Detail 20C and mount the tuning capacitor at AL on the front panel with a control flatwasher and a control nut. Position the video-RF circuit board as shown.

Refer to Pictorial 21 (fold-out from Page 35) for the following steps.

( ) Bend lug 2 of fuseholder CN out as shown.

( ) Connect the red stranded wire from BO#2 to lug 2 of fuseholder CN (S-1).

The brown and black stranded wires from BO#2 will be connected later.

Connect the wires from BO#1 as follows:

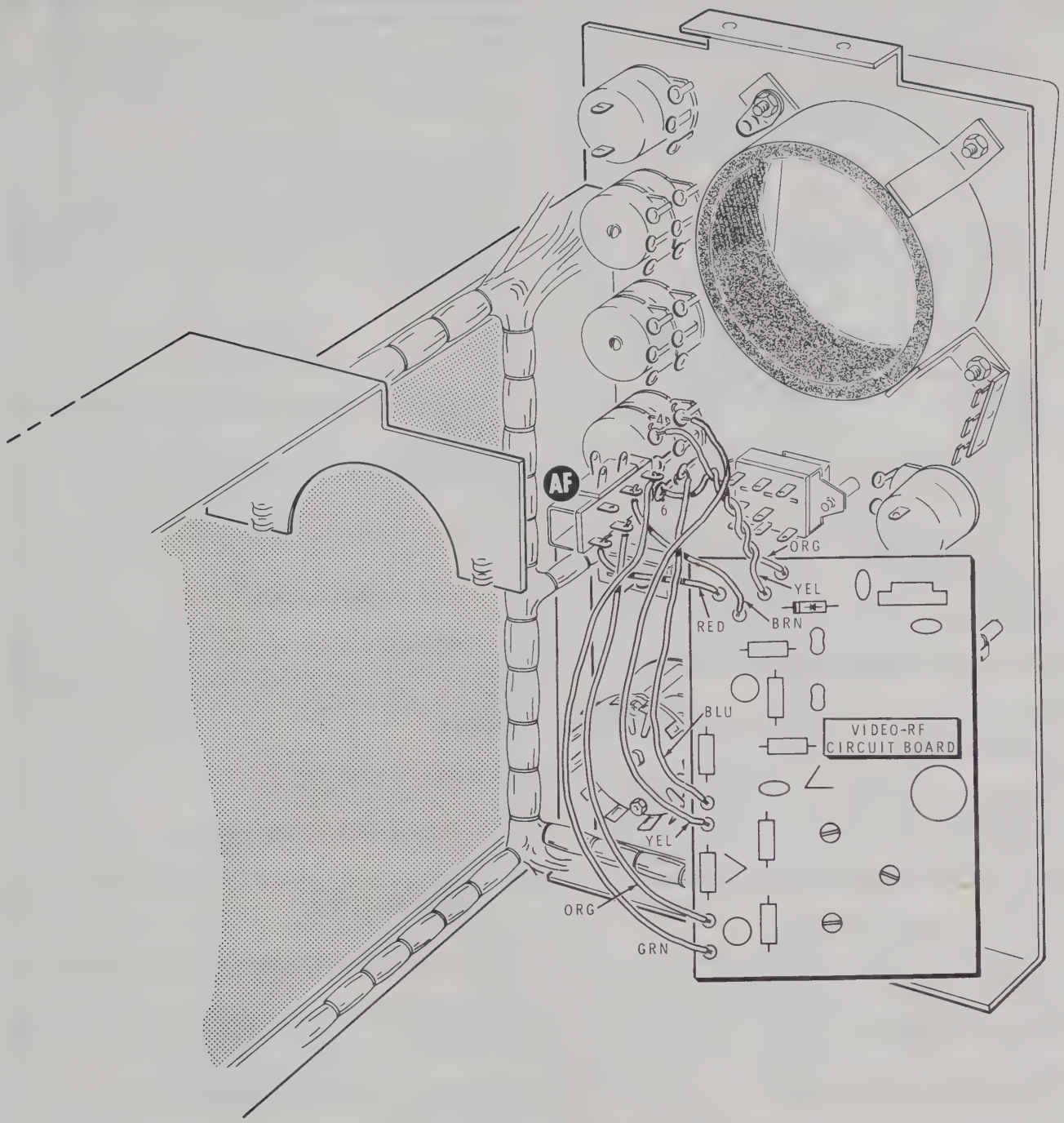
( ) Green to lug 1 of terminal strip CF (S-3).

( ) Red to lug 2 of terminal strip CF (S-3).

( ) Blue to lug 4 of terminal strip CF (S-3).

( ) White-black to lug 5 of terminal strip CF (S-2).

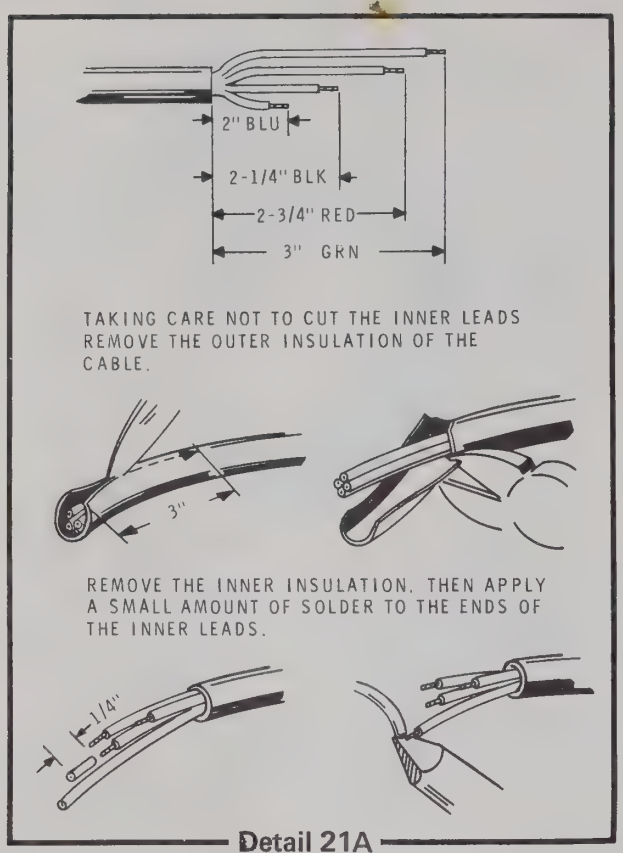
( ) White to lug 2 of switch CG (S-1).



PICTORIAL 20

( ) Black to lug 5 of switch CG (S-1).
( ) Brown to lug 8 of switch CG (S-1).
( ) Gray to lug 11 of switch CG (S-1).

( ) White-gray to lug 4 of terminal strip CH (S-2).
( ) White-yellow to lug 2 of terminal strip CH (S-2).
( ) White-violet to lug 1 of terminal strip CH (S-2).



Detail 21A

(✓) Refer to Detail 21A and prepare one end of the 4-wire cable as shown.

(✓) Pass this end of the 4-wire cable through hole CL in the rear panel.

Connect the 4-wire cable to terminal strip CE as follows:

(✓) Green wire to lug 1 (S-2).

(✓) Red wire to lug 2 (S-3).

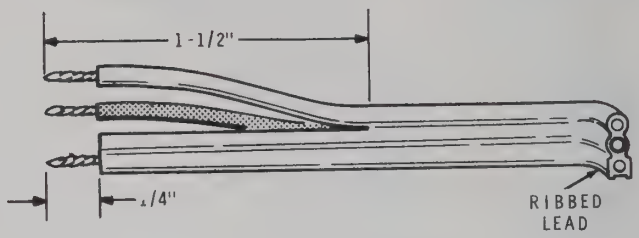
(✓) Black wire to lug 3 (S-1).

(✓) Blue wire to lug 4 (S-3).

NOTE: A flat 3-wire line cord is supplied with this kit, which is approved for use in the U.S.A. and in some other countries. If this cord is not approved for your locality, obtain locally an approved cord and proceed with the following steps, making changes where necessary.

The flat 3-wire line cord supplied with this kit has one of its outer wires marked with a rib in the insulation along its edge. The other wire is smooth, and the third wire is color coded green. It is very important that you connect the ribbed wire as indicated.

( ) Refer to Detail 21B and prepare the end of the 3-wire line cord.



3-WIRE LINE CORD

Detail 21B

(✓) Pass the 3-wire line cord through hole CP in the rear panel.

Connect the 3-wire line cord to socket CJ as follows:

(✓) Smooth wire to lug 1 (S-3).

(✓) Ribbed wire to lug 2 (S-3).

NOTE: When soldering to lug 3 of the AC sockets, as in the following step, a large soldering iron may be required to supply the additional heat needed to obtain a good connection.

(✓) Green wire to lug 3 (S-4).

Refer to Detail 21C for the following steps.

(✓) Install the small shielded cable strain relief on the shielded cable at CR.

(✓) Install the line cord strain relief on the line cord at CP.

(✓) Install the 4-wire cable strain relief on the 4-wire cable at CL.

Refer to Detail 21D for the following steps.

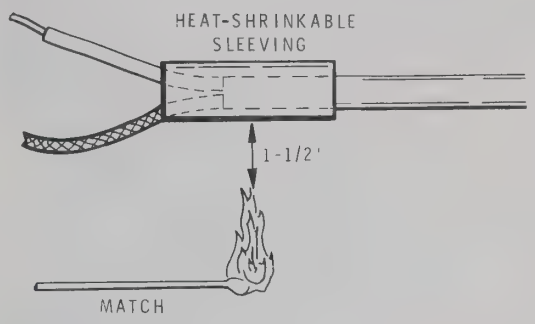
(✓) Cut the length of heat-shrinkable sleeving in half.

(✓) Install one piece of it on the free end of the shielded cable extending from hole CR in the rear panel as shown.

(✓) Push the red alligator clip insulator onto the inner lead of the shielded cable and a black alligator clip insulator onto the shield lead.



( ) Install plain alligator clips (not insulation-piercing clips) on the inner lead and the shield lead of the shielded cable. Then push the insulators down over the clips.

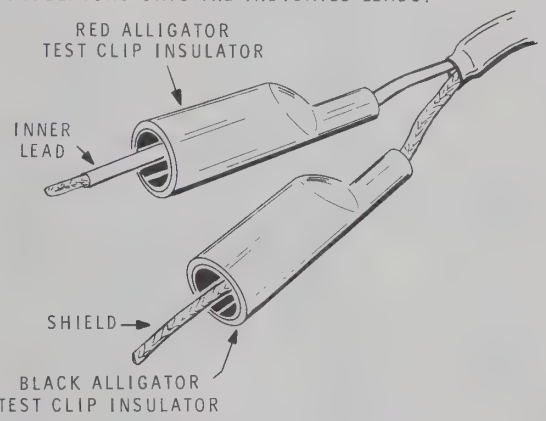


(1) CENTER THE SLEEVING OVER THE LEADS AND THE OUTER CABLE INSULATION.

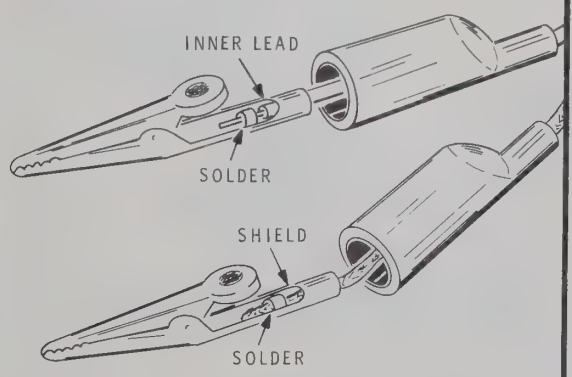
(2) USE THE HEAT FROM A MATCH TO SHRINK THE SLEEVING. ROTATE THE CABLE TO SHRINK THE SLEEVING EVENLY.

NOTE: DO NOT PLACE THE HEAT TOO CLOSE TO THE SLEEVING, AS IT CAN MELT.

SLIP THE RED AND BLACK ALLIGATOR TEST CLIP INSULATORS ONTO THE INDICATED LEADS.



INSERT EACH LEAD INTO AN ALLIGATOR TEST CLIP AND SOLDER AS SHOWN.



Detail 21D

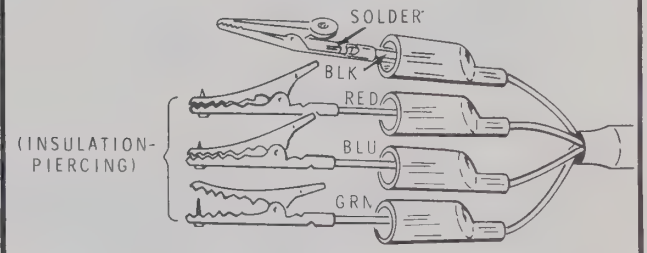
CUT THE CABLE ACCORDING TO THE DIMENSIONS BELOW. PREPARE THE END AS SHOWN.



SLIP THE LENGTH OF HEAT-SHRINKABLE SLEEVING ONTO THE END OF THE CABLE. POSITION THIS SLEEVING APPROXIMATELY 1/2" OVER THE OUTER INSULATION. HEAT LONG ENOUGH TO SHRINK THE SLEEVING TIGHTLY AROUND THE CABLE.



SLIP AN ALLIGATOR TEST CLIP INSULATOR ONTO EACH LEAD AT THE END OF THE CABLE. INSERT THE PROPER LEAD INTO THE INDICATED ALLIGATOR TEST CLIP AND SOLDER.



Detail 21E

Refer to Detail 21E for the following steps.

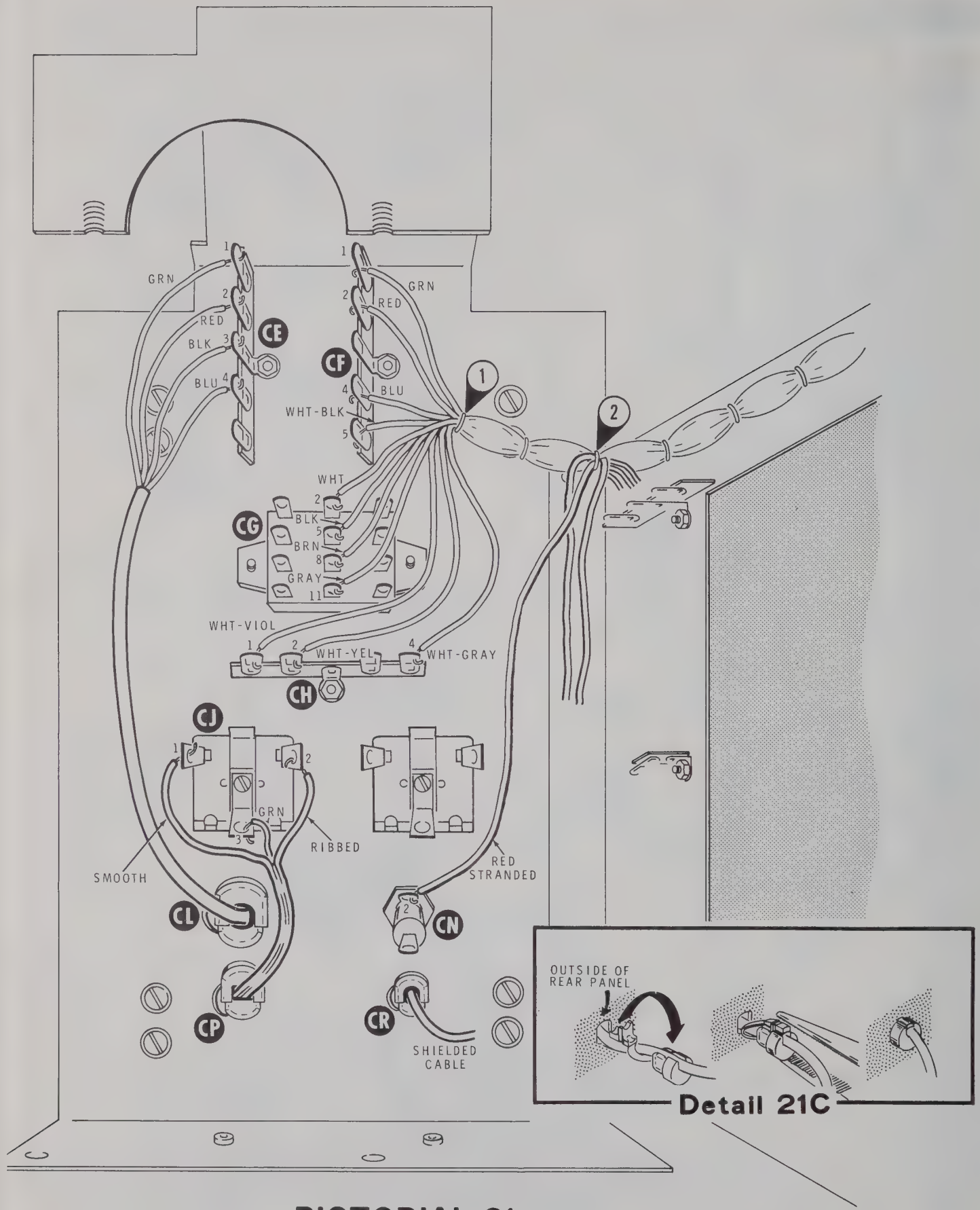
(✓) Remove 5" of outer insulation from the end of the 4-wire cable. Then remove 1/4" of insulation from the end of each wire.

(✓) Locate the remaining length of heat-shrinkable sleeving and install it on the 4-wire cable as shown. It may be necessary to stretch the sleeving to allow it to pass over the outer insulation of the cable.

(✓) Push the black alligator clip insulator onto each wire.

(✓) Install the remaining plain alligator clip (not an insulation-piercing clip) on the black wire of the 4-wire cable. Then push the insulator down over the clip.

(✓) Install insulation-piercing alligator clips on the remaining wires of the 4-wire cable. Then push the insulators down over the clips.



PICTORIAL 21

( ) Connect either green lead to lug 12 of the CRT socket (S-1).

( ) Connect the remaining green lead to lug 1 of the CRT socket (S-2).

( ) Connect the black stranded wire from BO#2 to lug 3 of the transformer (NS).

ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given below, one for 120 VAC line voltage and the other for 240 VAC line voltage. In the U.S.A. 120 VAC is most often used, while in foreign countries 240 VAC is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

120 VAC Wiring

Refer to Detail 22C for the following steps.

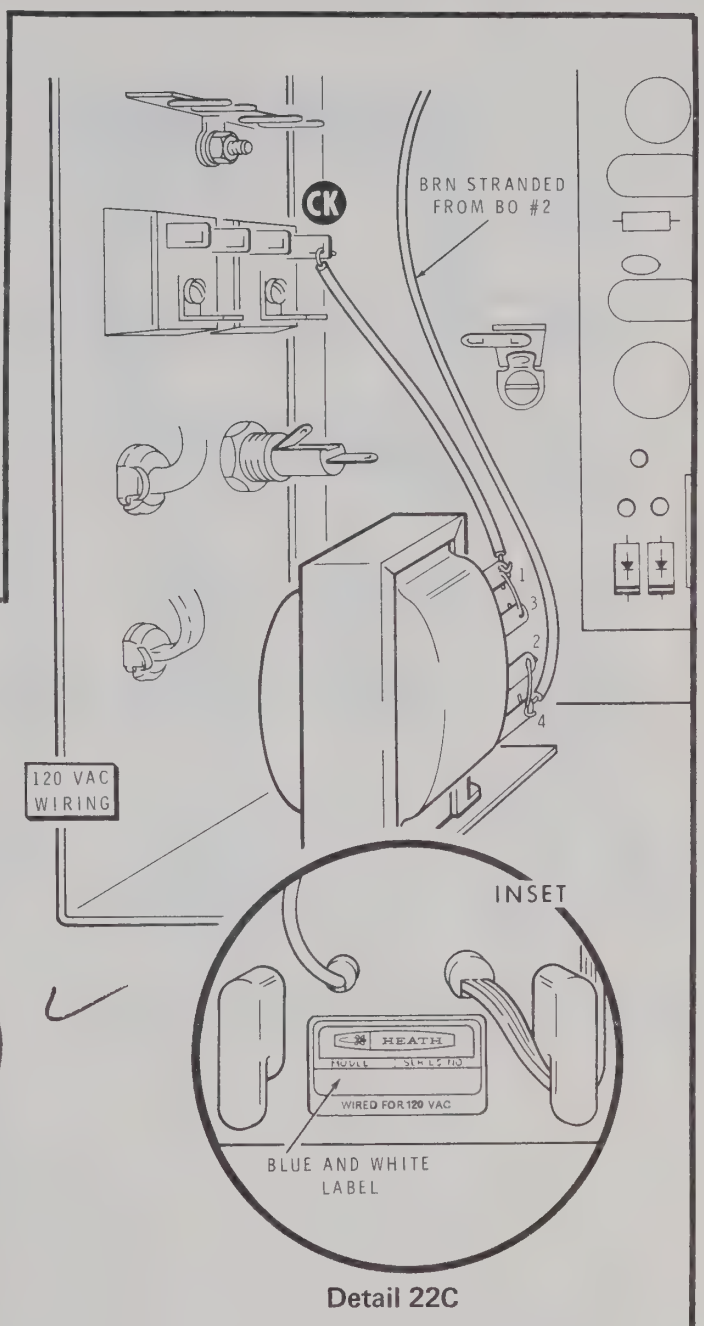
( ) Connect a 1" length of bare wire between lug 1 (NS) and lug 3 (S-2) of the power transformer.

( ) Connect a 1" length of bare wire between lug 2 (S-1) and lug 4 (NS) of the power transformer.

( ) Connect the free end of the brown stranded wire extending from socket CK to lug 1 of the power transformer (S-2).

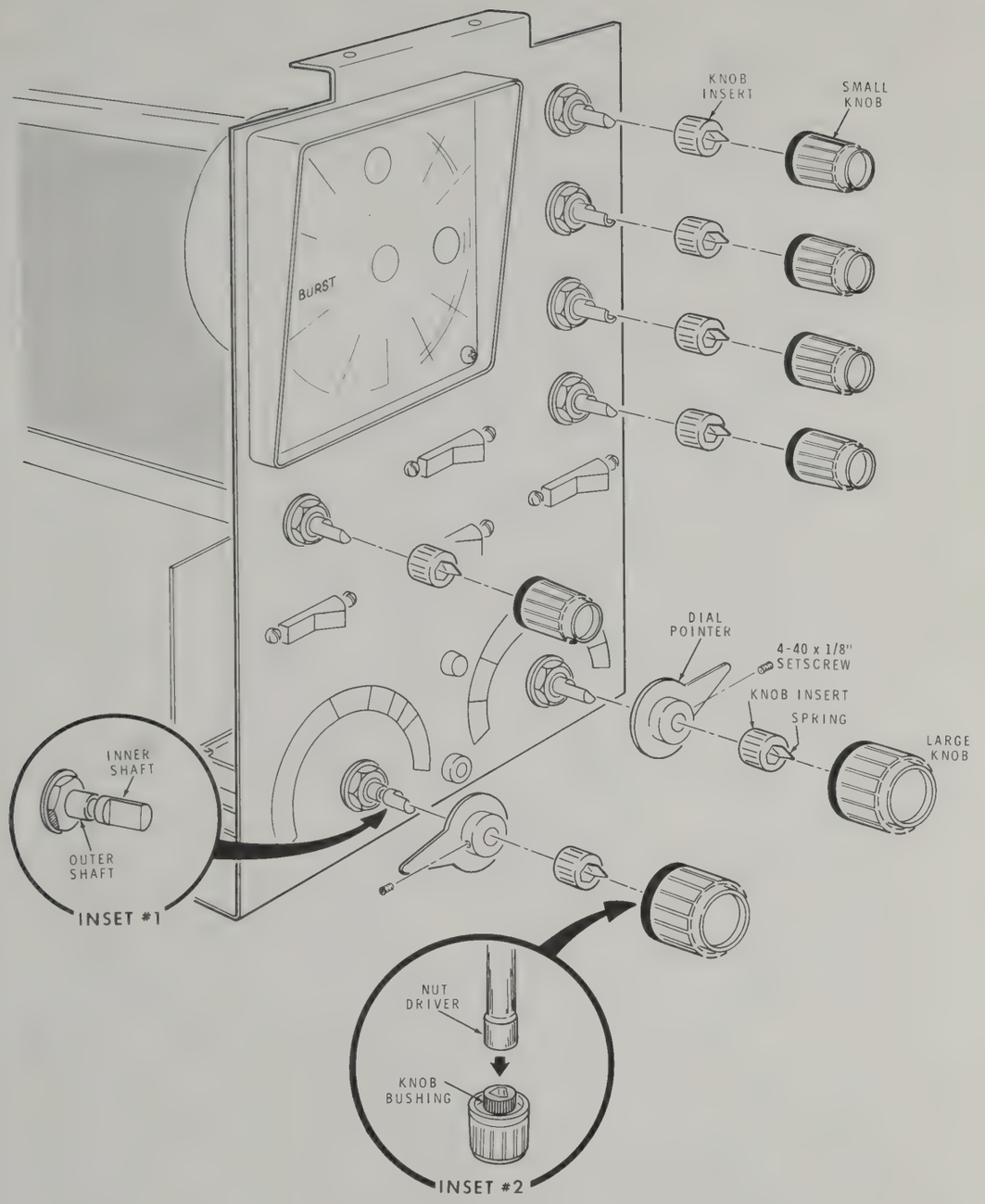
( ) Connect the free end of the brown stranded wire from BO#2 to lug 4 of the power transformer (S-2).

( ) Carefully peel away the backing paper from the blue and white identification label. Then press the label onto the rear panel as shown in the inset drawing of Detail 22C. Be sure to position the label over "Wired For 240 VAC" - leave "Wired For 120 VAC" exposed.



Detail 22C

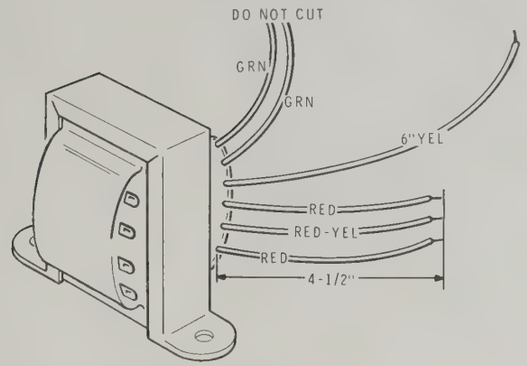




Detail 23A

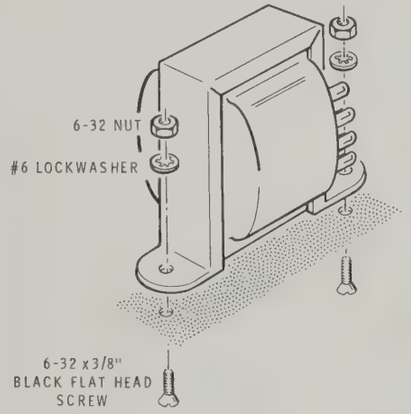
Refer to Pictorial 22 for the following steps.

( ) Refer to Detail 22A and cut the power transformer leads to the indicated lengths. Measure the leads from where they come out of the transformer. Then remove 1/4" of insulation from the end of each lead.



Detail 22A

( ) Refer to Detail 22B and mount the power transformer to the rear panel with 6-32 x 3/8" black flat head screws, #6 lockwashers, and 6-32 nuts as shown.

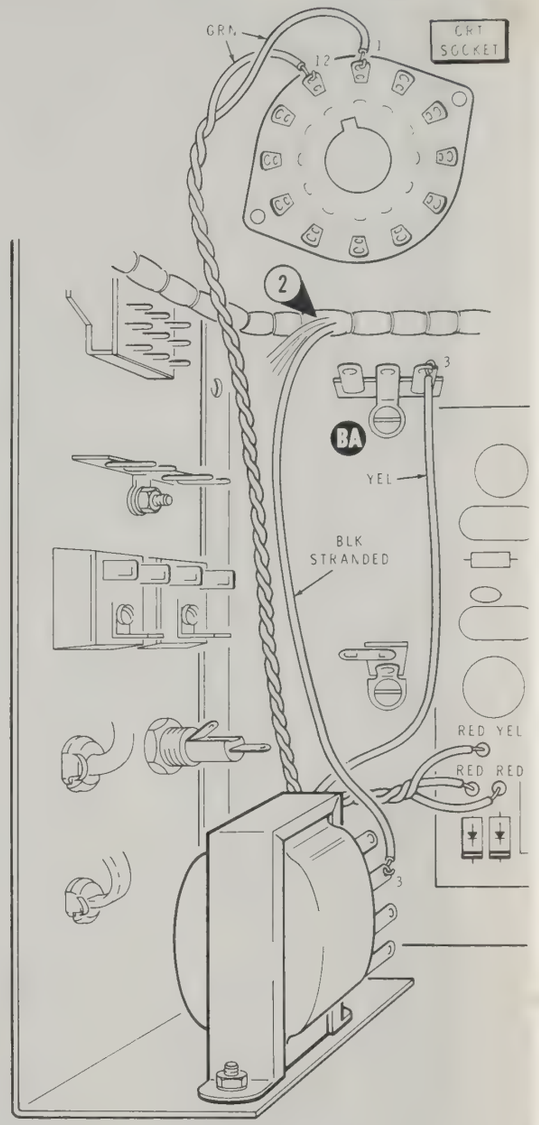


Detail 22B

( ) Connect the yellow transformer lead to lug 3 of terminal strip BA (S-2).

( ) Twist together the two red and the red-yellow leads.

( ) Connect the red-yellow lead to the circuit board hole marked RED/YEL (S-1).



PICTORIAL 22

( ) Connect either red lead to the circuit board hole marked RED (S-1).

( ) Connect the other red lead to the remaining circuit board hole marked RED (S-1).

( ) Twist together the green transformer leads.

( ) Connect either green lead to lug 12 of the CRT socket (S-1).

( ) Connect the remaining green lead to lug 1 of the CRT socket (S-2).

( ) Connect the black stranded wire from BO#2 to lug 3 of the transformer (NS).

ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given below, one for 120 VAC line voltage and the other for 240 VAC line voltage. In the U.S.A. 120 VAC is most often used, while in foreign countries 240 VAC is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

120 VAC Wiring

Refer to Detail 22C for the following steps.

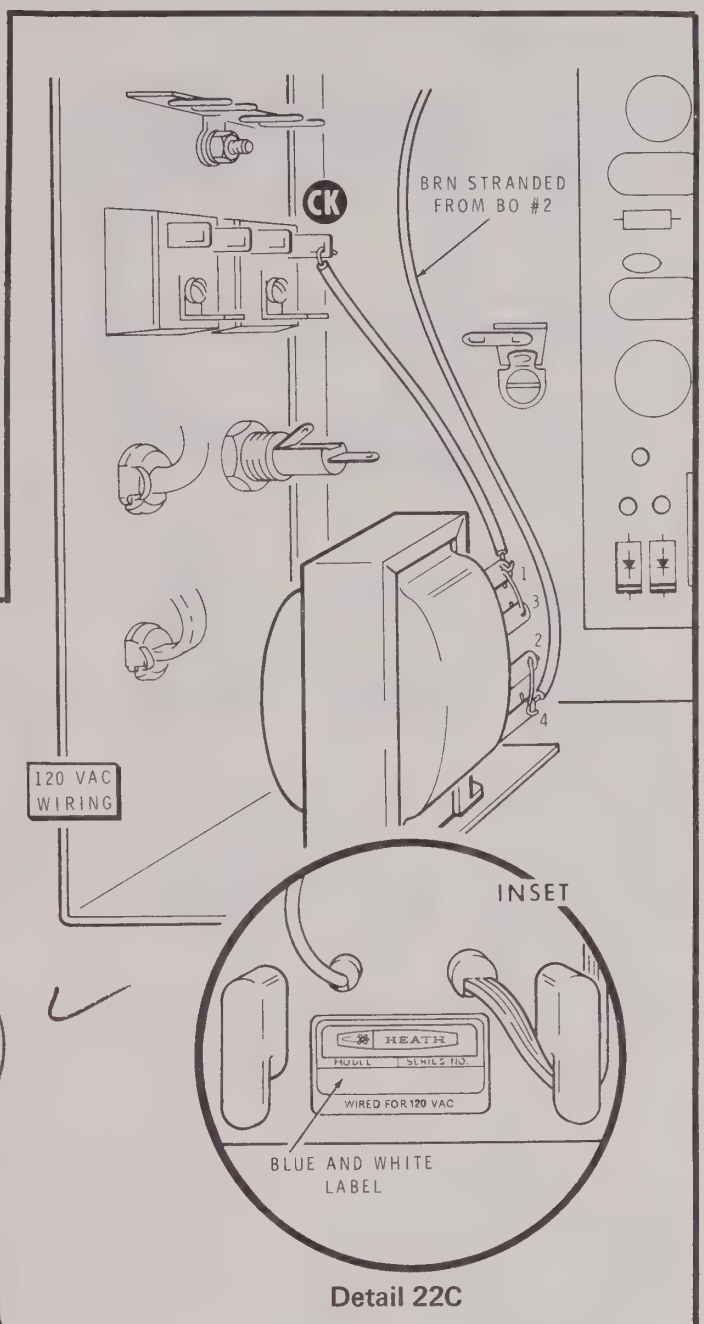
( ) Connect a 1" length of bare wire between lug 1 (NS) and lug 3 (S-2) of the power transformer.

( ) Connect a 1" length of bare wire between lug 2 (S-1) and lug 4 (NS) of the power transformer.

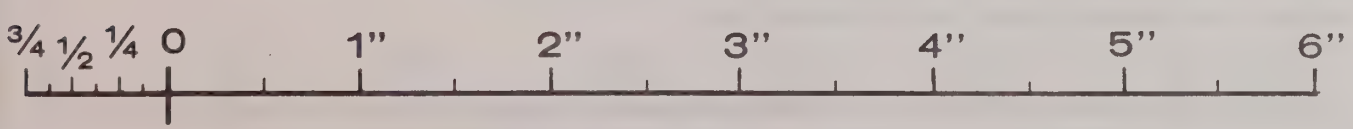
( ) Connect the free end of the brown stranded wire extending from socket CK to lug 1 of the power transformer (S-2).

( ) Connect the free end of the brown stranded wire from BO#2 to lug 4 of the power transformer (S-2).

( ) Carefully peel away the backing paper from the blue and white identification label. Then press the label onto the rear panel as shown in the inset drawing of Detail 22C. Be sure to position the label over "Wired For 240 VAC" - leave "Wired For 120 VAC" exposed.



Detail 22C



240 VAC Wiring

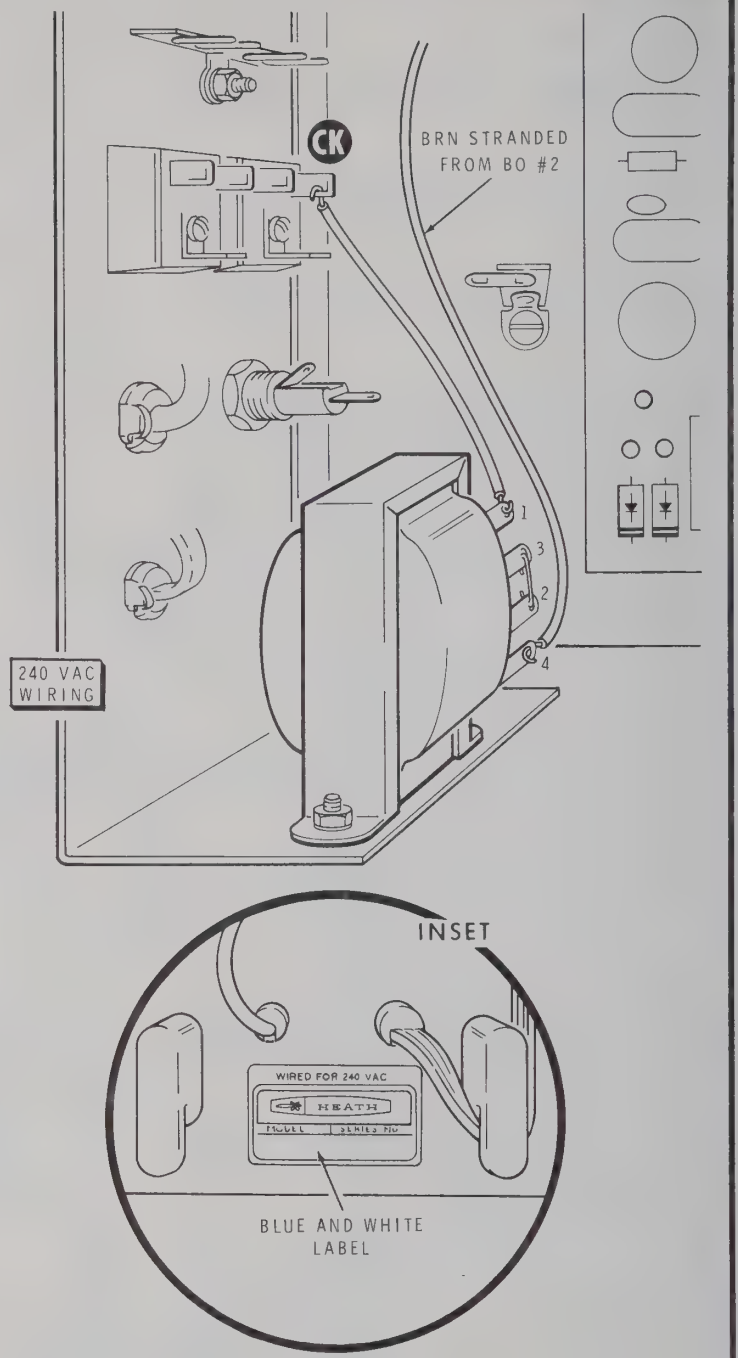
Refer to Detail 22D for the following steps.

( ) Connect a 1" length of bare wire between lug 3 (S-2) and lug 2 (S-1) of the power transformer.

( ) Connect the free end of the brown stranded wire extending from socket CK to lug 1 of the power transformer (S-1).

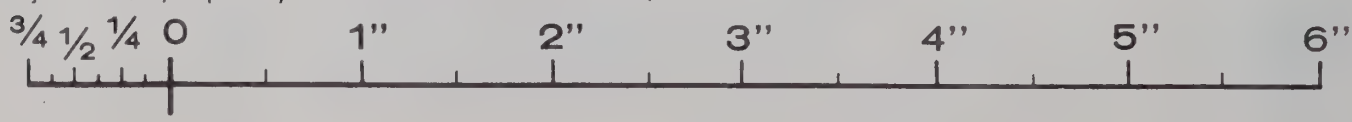
( ) Connect the free end of the brown stranded wire from BO#2 to lug 4 of the power transformer (S-1).

( ) Carefully peel away the backing paper from the blue and white identification label. Then press the label onto the rear panel as shown in the inset drawing of Detail 22D. Be sure to position the label over "Wired For 120 VAC" - leave "Wired For 240 VAC" exposed.



Detail 22D

This completes the wiring of your Vectorscope. Carefully inspect the circuit boards to be sure all connections are properly soldered, and that no solder bridges exist across adjacent foils, especially around the IC sockets. Also, examine the chassis wiring to be sure there are no wire clippings or solder splashes lodged in the wiring or across any connections.



KNOB INSTALLATION

Refer to Pictorial 23 and Detail 23A (fold-out from Page 36) for the following steps.

(✓) Turn all of the control shafts, except the Pattern switch, on the front panel to their full counterclockwise position.

(✓) Turn the Pattern switch shaft fully clockwise.

(✓) Use the allen wrench to start a 4-40 x 1/8" setscrew in one of the dial pointers. Push the dial pointer all the way onto the Pattern switch shaft. Position the dial pointer as shown and tighten the setscrew.

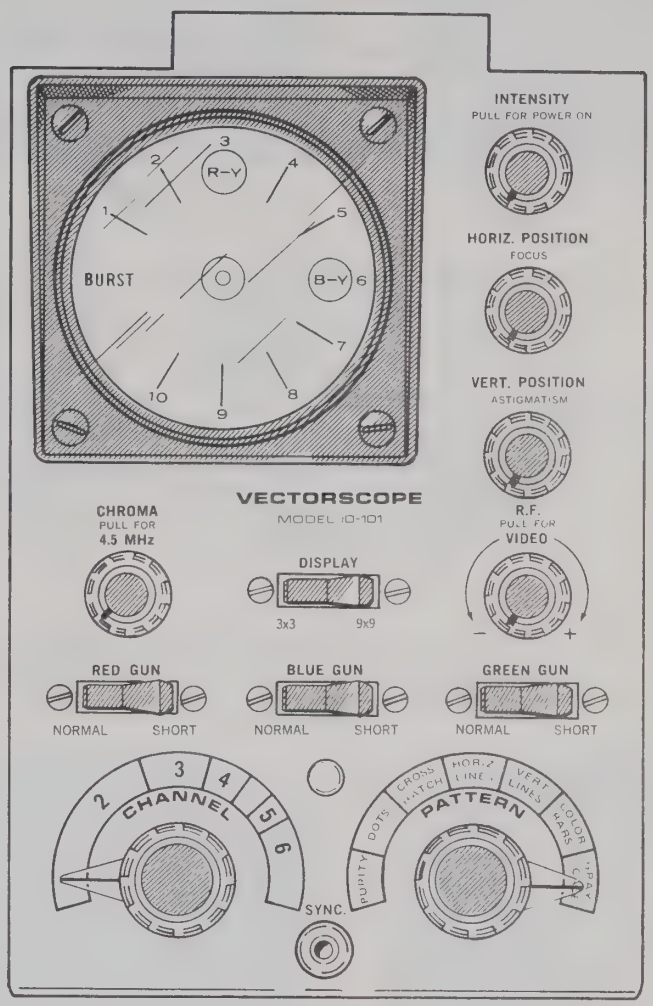
(✓) In the same manner, start a 4-40 x 1/8" setscrew in the remaining dial pointer. Push the dial pointer all the way onto the Channel tuning shaft. NOTE: There is an outer shaft and an inner shaft. Install the pointer on the outer shaft. Refer to inset drawing #1 on Detail 23A.

(✓) Push a knob insert onto the Pattern switch shaft. Then press a large knob part way onto the insert.

(✓) Remove both the knob and knob insert. Refer to inset drawing #2 of Detail 23A and press the insert all the way into the knob cavity with a nutdriver or other suitable instrument. Replace the knob on the Pattern switch shaft.

(✓) In the same manner, install the remaining large knob on the Channel tuning shaft.

(✓) Install the small knobs on the Chroma, Intensity, Horizontal Position, Vertical Position, and Video-RF control shafts in the same manner as above. Position the knobs so their pointers are as shown, with the control shafts turned fully counterclockwise.



PICTORIAL 23

HANDLE INSTALLATION

Refer to Pictorial 24 for the following steps.

(2) Mount the top rail to the front and rear panels with 6-32 x 1/4" phillips head screws.

(4) Unpack the handle, end caps, and clamps.

(1) Position the handle on the top rail with the curved side of the handle toward the rail as shown. Then mount the handle to the top rail with the clamps, 4-40 x 3/4" black screws, #4 lockwashers, and 4-40 nuts. Do not overtighten this hardware.

(3) Install both end caps over the handle brackets by lining up the hole in the cap and the pin on the clamp. Then press the end cap down until it snaps in place.

(5) Carefully peel away the backing paper from the Heathkit nameplate. Then press the nameplate in place on the front panel above the bezel.

CRT INSTALLATION

Refer to Pictorial 25 (fold-out from Page 41) for the following steps.

WARNING: Extreme care must be exercised when handling the CRT due to its high vacuum. Do not strike, scratch, or subject the CRT to more than moderate pressure at any time. A fracture of the glass could result in an implosion of considerable violence capable of causing personal injury.

( ) Carefully unpack the CRT.

( ) Insert the CRT into the CRT ring and push it against the graticule. Position the key of the tube base as shown.

( ) Secure the CRT to the chassis with the two CRT clamps, the cushion strip, and two #6 x 1/2" sheet metal screws.

( ) Line up the keyway of the CRT socket with the locating key of the CRT base and push the socket on the CRT.

( ) Install the 1/4-ampere slow-blow fuse in fuseholder CN.

Proceed to the "Test and Adjustments" section, which follows.

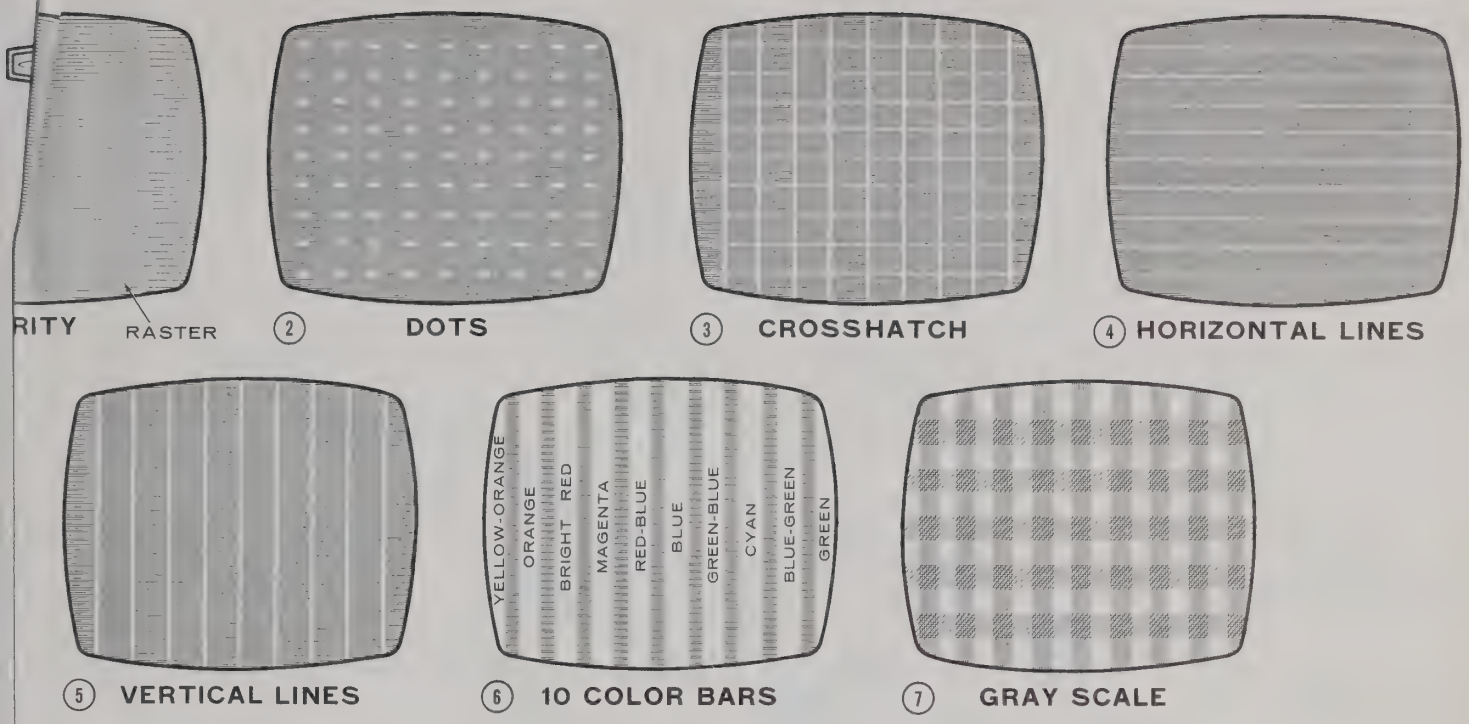


FIGURE 3A

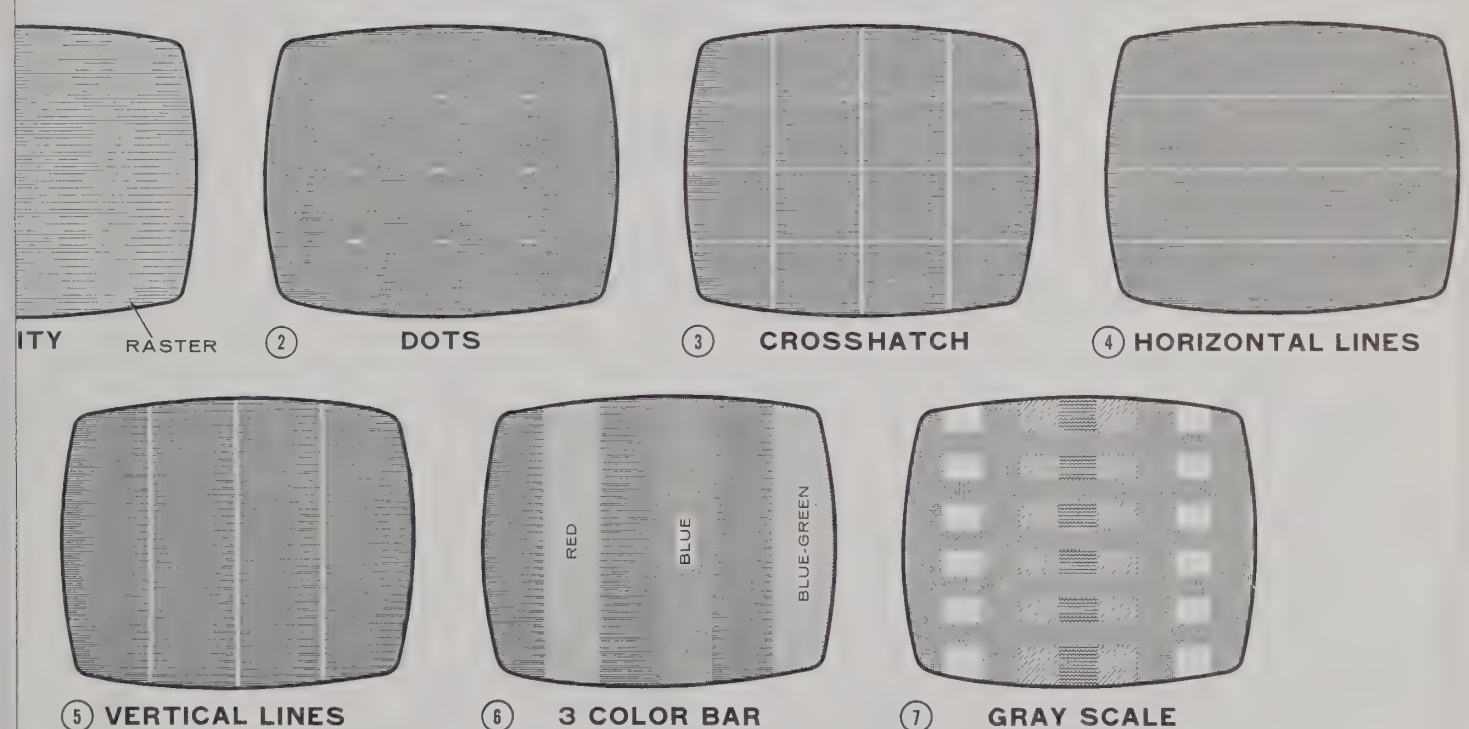


FIGURE 3B

HANDLE INSTALLATION

Refer to Pictorial 24 for the following steps.

(2) Mount the top rail to the front and rear panels with 6-32 x 1/4" phillips head screws.

(4) Unpack the handle, end caps, and clamps.

(1) Position the handle on the top rail with the curved side of the handle toward the rail as shown. Then mount the handle to the top rail with the clamps, 4-40 x 3/4" black screws, #4 lockwashers, and 4-40 nuts. Do not overtighten this hardware.

(3) Install both end caps over the handle brackets by lining up the hole in the cap and the pin on the clamp. Then press the end cap down until it snaps in place.

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CRT INSTALLATION

Refer to Pictorial 25 (fold-out from Page 41) for the following steps.

WARNING: Extreme care must be exercised when handling the CRT due to its high vacuum. Do not strike, scratch, or subject the CRT to more than moderate pressure at any time. A fracture of the glass could result in an implosion of considerable violence capable of causing personal injury.

( ) Carefully unpack the CRT.

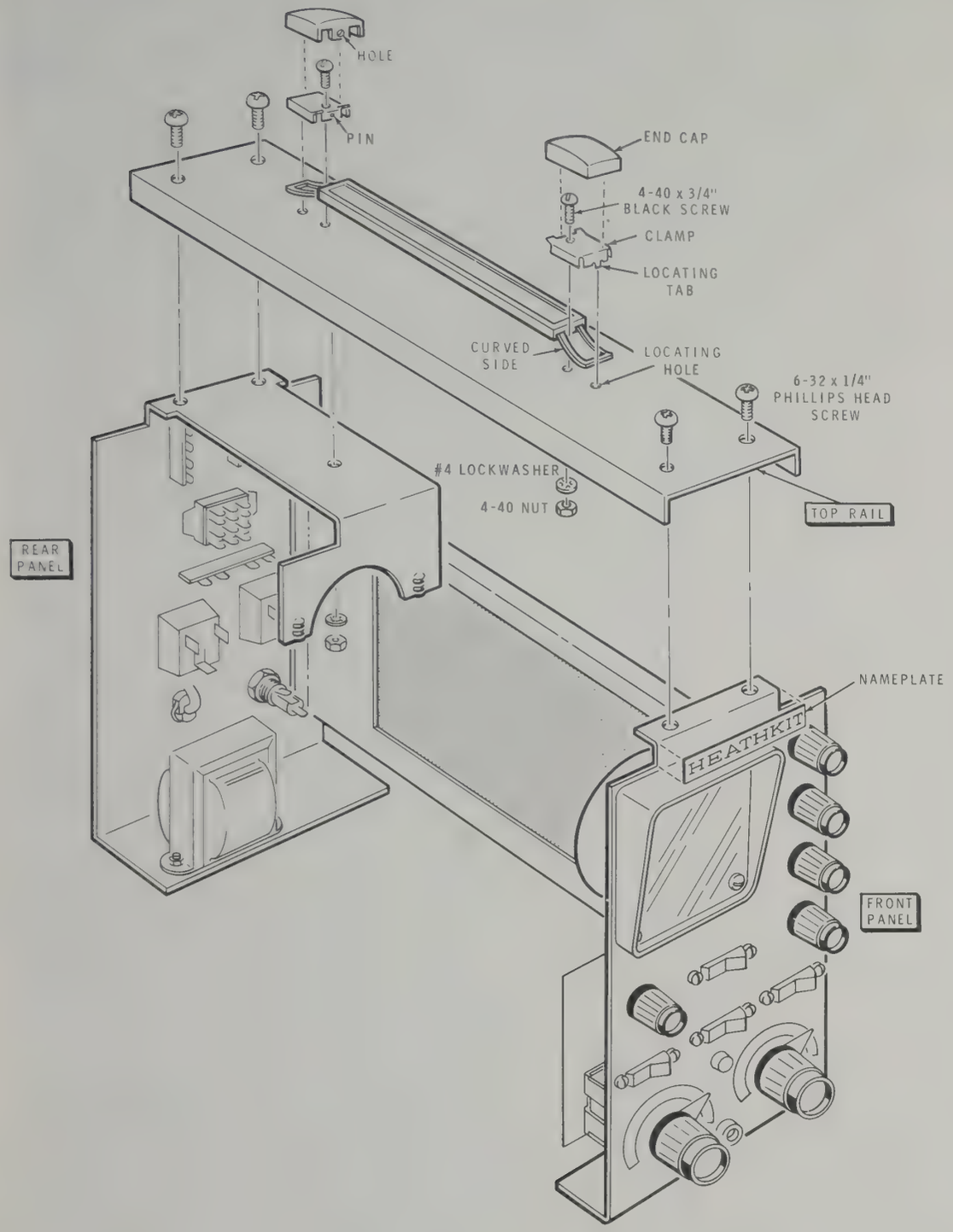
( ) Insert the CRT into the CRT ring and push it against the graticule. Position the key of the tube base as shown.

( ) Secure the CRT to the chassis with the two CRT clamps, the cushion strip, and two #6 x 1/2" sheet metal screws.

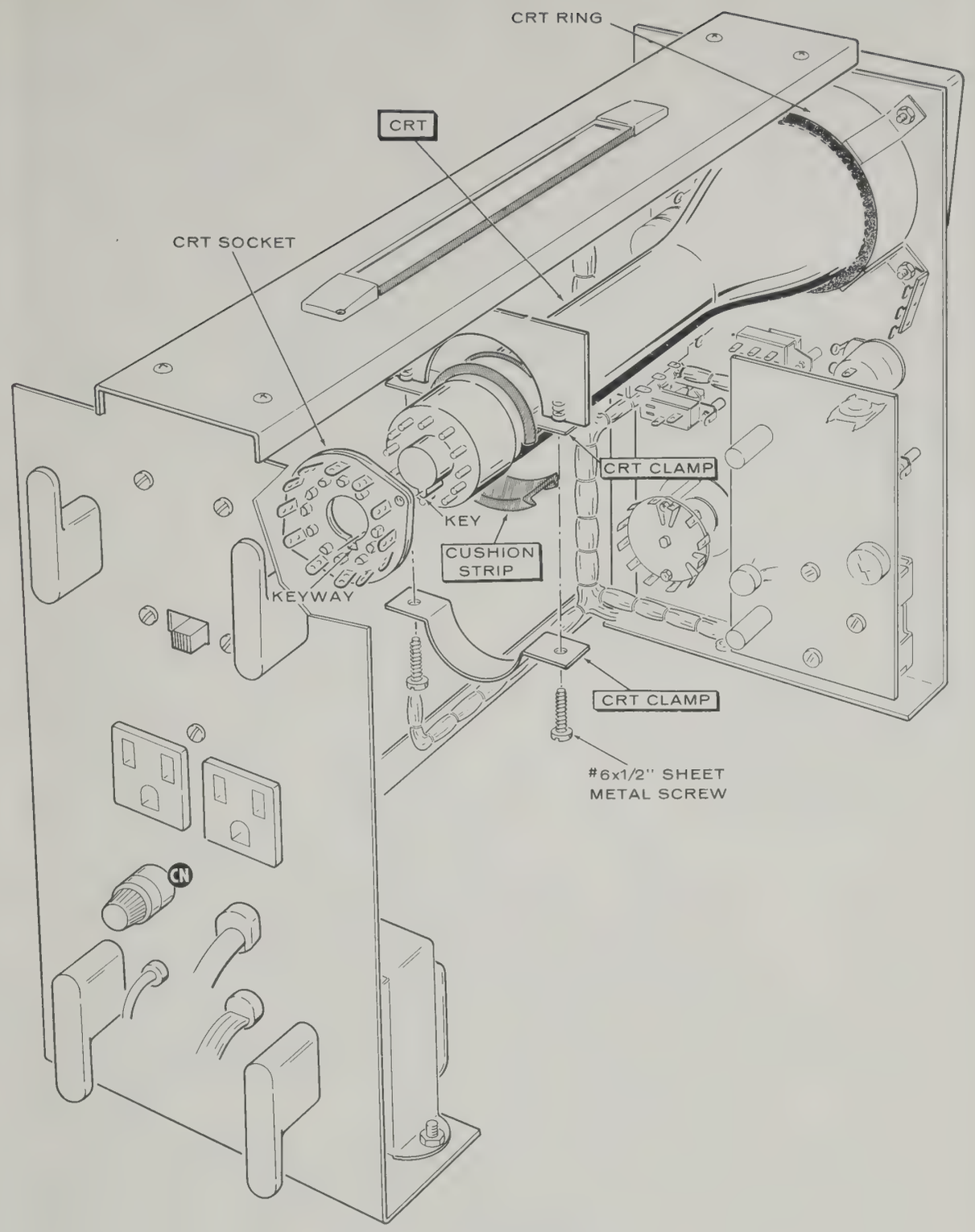
( ) Line up the keyway of the CRT socket with the locating key of the CRT base and push the socket on the CRT.

( ) Install the 1/4-ampere slow-blow fuse in fuseholder CN.

Proceed to the "Test and Adjustments" section, which follows.



PICTORIAL 24



PICTORIAL 25

TEST AND ADJUSTMENTS

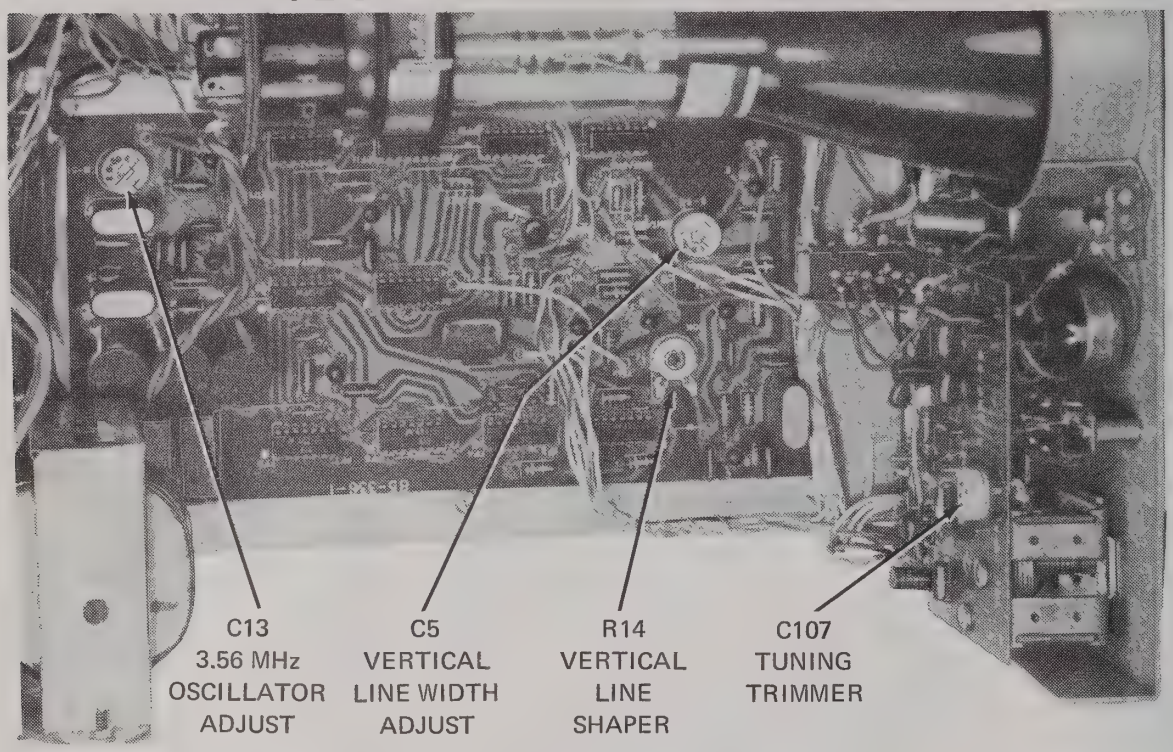


Figure 1

In this section of the Manual, you will test the operation of your Vectorscope and make necessary adjustments before you complete the "Final Assembly." If any trouble is encountered in the following tests or adjustments, turn the power off and refer to the "In Case of Difficulty" section on Page 60.

The following resistance checks are only intended to double check your assembly work. Therefore, if you do not have an ohmmeter, proceed to the "Generator" tests. If you do have an ohmmeter, the following measurements will help you determine at this time if you have made any assembly errors.

Figure 6 (fold-out from Page 73) shows the front and rear panels of the Vectorscope. Study the figure carefully to identify the function of each switch, control, jack, and socket.

RESISTANCE CHECKS

NOTE: The internal wiring of most ohmmeters is such that the positive terminal of the meter battery is connected to the positive (red) test lead and the negative battery terminal is connected to the negative (black) test lead. In some ohmmeters this wiring is reversed, and erroneous readings will be obtained when making the following measurements. Try reversing the ohmmeter leads if the measurements do not check out correctly at first.

Refer to Pictorial 18 (fold-out from Page 29) for the following steps.

( ) Set the ohmmeter on the RX100 range, and connect the leads between lug 9 of rotary switch AN and chassis ground. The resistance reading should be 200 Ω or higher. A very low resistance reading (100 Ω or less) could indicate a solder bridge between two adjacent foils on the circuit board or perhaps a diode installed incorrectly.

( ) Connect the ohmmeter between the BLACK ground and the RED lead of the 4-wire cable. With the RED GUN switch in the NORMAL position, the reading should be infinite. In the SHORT position, the reading should be approximately 100 kΩ ±10%.

( ) Repeat the procedure with the BLUE lead.

( ) Repeat the procedure with the GREEN lead.

GENERATOR TESTS AND ADJUSTMENTS

Refer to Figure 1 for the following steps.

NOTE: A black and white TV receiver may be used for all of the following adjustments except for the color bar displays, the vector displays, and the adjustment of the 3.56 MHz oscillator.

( ) Turn a color telecast on any channel from 2 through 6 on an operating color television receiver.

( ) Carefully adjust the receiver horizontal and vertical hold controls for a locked-in picture.

( ) Adjust the tint control of the receiver to produce the correct color for the picture displayed. Do not change the setting of the tint, horizontal, or vertical hold controls for the balance of this test procedure.

Set the controls on the front panel of the Vectorscope as follows:

( ) INTENSITY – Center of rotation and pushed in.

( ) HORIZ. POSITION – Center of rotation.

( ) VERT. POSITION – Center of rotation.

( ) RF-VIDEO – Fully clockwise and pushed in.

( ) CHROMA - 4.5 MHz – Center of rotation and pushed in.

( ) CHANNEL – Fully counterclockwise.

( ) PATTERN – HORIZONTAL LINES.

( ) DISPLAY – 9 x 9.

( ) RED GUN – NORMAL.

( ) BLUE GUN – NORMAL.

( ) GREEN GUN – NORMAL.

( ) Disconnect the TV receiver antenna and connect the Vectorscope shielded output cable to the antenna input terminals of the receiver. The 4-wire cable will be connected later.

( ) Turn off the AFT (Automatic Fine Tuning) and any other automatic tuning feature if your TV receiver is equipped with it.

( ) Turn the CHANNEL tuning of the Vectorscope to the same channel as the television receiver.

NOTE: The line cord is equipped with a polarized plug. Therefore, an adapter has been included in case your house wiring is not equipped with polarized sockets. When you use this adapter, the green wire should be connected under a screw that is connected to earth ground.

( ) Plug the Vectorscope line cord into an AC outlet of the proper voltage (120 or 240 VAC, depending upon the connection of the power transformer primary winding).

WARNING: High voltage (825 volts) is present at several locations within the Vectorscope.

( ) Pull the POWER switch to the "on" position.

( ) Locate the 1/8" x 1" metal strip. This is the alignment tool tip. With a pair of pliers, insert the tip into the small end of the nut starter so that it extends 1/8" from the end of the starter as shown in Figure 2.

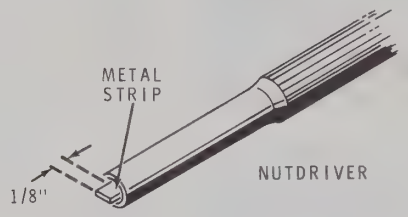


Figure 2

( ) Refer to Figure 1 and use the alignment tool to slowly turn TUNING TRIMMER capacitor C107 (on the video-RF circuit board). As the trimmer is slowly rotated, a pattern will appear on the TV screen. There should be eight to ten horizontal lines in the pattern.

( ) Turn the PATTERN to CROSSHATCH.

NOTE: Keep the brightness control on the TV receiver at a low level to prevent blooming (wide unfocussed lines). It is normal for the vertical lines to be wider than the horizontal lines.

( ) Adjust VERTICAL LINE WIDTH trimmer capacitor C5 until horizontal and vertical lines of approximately the same intensity appear on the screen.

( ) Note the intensity of the vertical lines on the screen, then switch the DISPLAY switch to 3 x 3. Adjust VERTICAL LINE SHAPER control R14 so that the vertical lines on the screen are the same intensity as the 9 x 9 pattern. Switch back and forth between the 3 x 3 and 9 x 9 pattern several times to obtain the correct intensity. Leave the DISPLAY switch in the 3 x 3 position.

( ) Rotate the RF level control through its full range. This should simulate a weak to a very strong signal to the receiver.

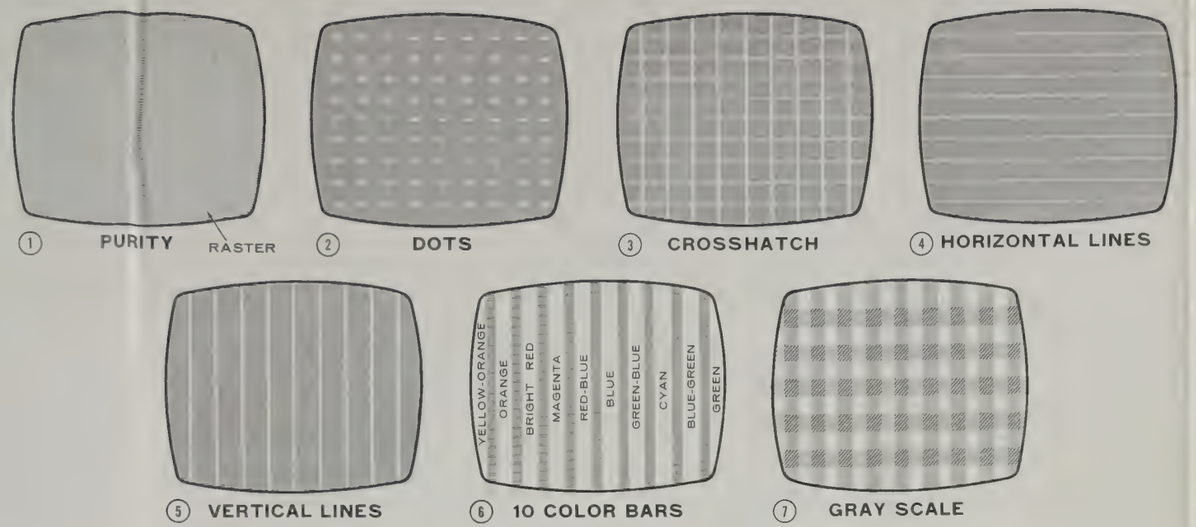


FIGURE 3A

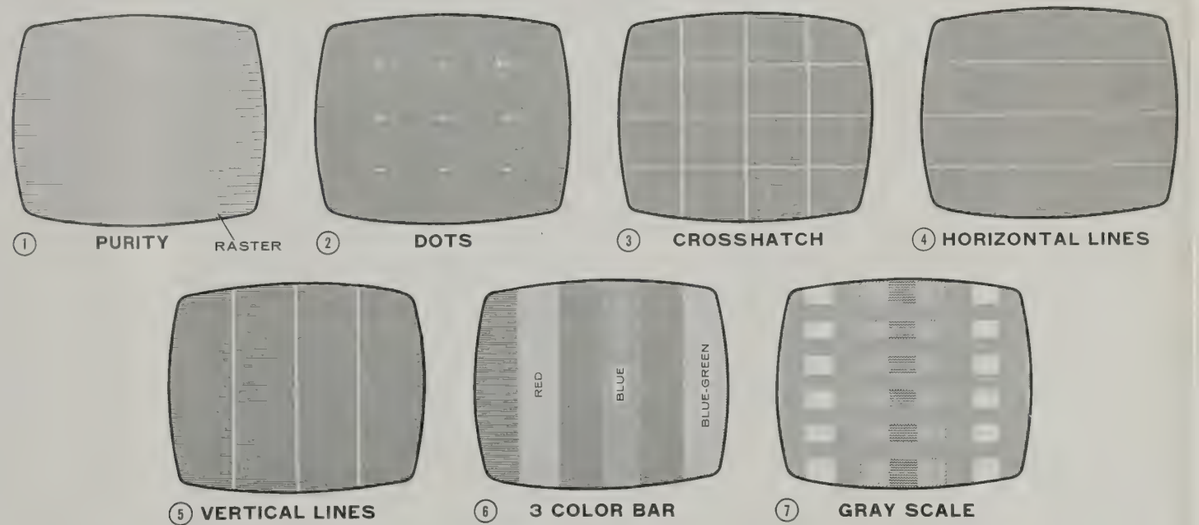


FIGURE 3B

TEST AND ADJUSTMENTS

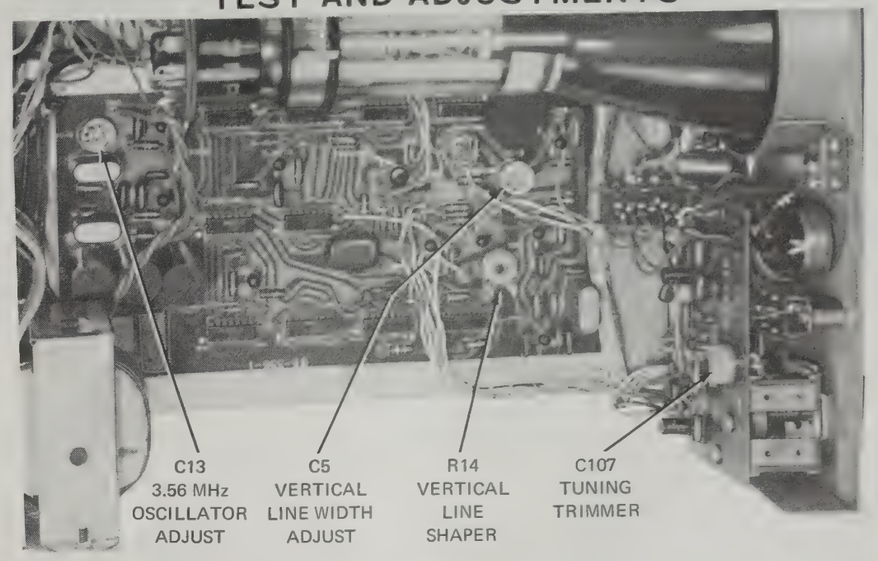


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( ) Repeat the procedure with the BLUE lead.

( ) Repeat the procedure with the GREEN lead.

GENERATOR TESTS AND ADJUSTMENTS

Refer to Figure 1 for the following steps.

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Set the controls on the front panel of the Vectorscope as follows:

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( ) HORIZ. POSITION – Center of rotation.

( ) VERT. POSITION – Center of rotation.

( ) RF-VIDEO – Fully clockwise and pushed in.

( ) CHROMA - 4.5 MHz – Center of rotation and pushed in.

( ) CHANNEL – Fully counterclockwise.

( ) PATTERN – HORIZONTAL LINES.

( ) DISPLAY – 9 x 9.

( ) RED GUN – NORMAL.

( ) BLUE GUN – NORMAL.

( ) GREEN GUN – NORMAL.

( ) Disconnect the TV receiver antenna and connect the Vectorscope shielded output cable to the antenna input terminals of the receiver. The 4-wire cable will be connected later.

( ) Turn off the AFT (Automatic Fine Tuning) and any other automatic tuning feature if your TV receiver is equipped with it.

( ) Turn the CHANNEL tuning of the Vectorscope to the same channel as the television receiver.

NOTE: The line cord is equipped with a polarized plug. Therefore, an adapter has been included in case your house wiring is not equipped with polarized sockets. When you use this adapter, the green wire should be connected under a screw that is connected to earth ground.

( ) Plug the Vectorscope line cord into an AC outlet of the proper voltage (120 or 240 VAC, depending upon the connection of the power transformer primary winding).

WARNING: High voltage (825 volts) is present at several locations within the Vectorscope.

( ) Pull the POWER switch to the "on" position.

( ) Locate the 1/8" x 1" metal strip. This is the alignment tool tip. With a pair of pliers, insert the tip into the small end of the nut starter so that it extends 1/8" from the end of the starter as shown in Figure 2.

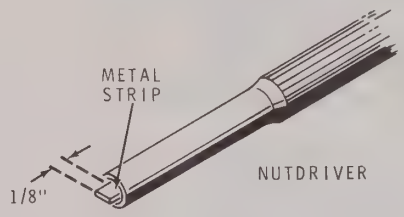


Figure 2

(√) Refer to Figure 1 and use the alignment tool to slowly turn TUNING TRIMMER capacitor C107 (on the video-RF circuit board). As the trimmer is slowly rotated, a pattern will appear on the TV screen. There should be eight to ten horizontal lines in the pattern.

(√) Turn the PATTERN to CROSSHATCH.

NOTE: Keep the brightness control on the TV receiver at a low level to prevent blooming (wide unfocussed lines). It is normal for the vertical lines to be wider than the horizontal lines.

(√) Adjust VERTICAL LINE WIDTH trimmer capacitor C5 until horizontal and vertical lines of approximately the same intensity appear on the screen.

(√) Note the intensity of the vertical lines on the screen, then switch the DISPLAY switch to 3 x 3. Adjust VERTICAL LINE SHAPER control R14 so that the vertical lines on the screen are the same intensity as the 9 x 9 pattern. Switch back and forth between the 3 x 3 and 9 x 9 pattern several times to obtain the correct intensity. Leave the DISPLAY switch in the 3 x 3 position.

(√) Rotate the RF level control through its full range. This should simulate a weak to a very strong signal to the receiver.

(✓) Turn the PATTERN switch to COLOR BARS.

(✓) Set the RF level control to the center of its range.

NOTE: When tuning the CHANNEL control, always start at the lower end of the band and tune clockwise. The first clockwise position that produces a display on the TV screen is the correct position.

( ) Fine tune the CHANNEL control to produce color in the bars. If the bars do not appear in color, adjust 3.56 MHz oscillator trimmer capacitor C13 to produce color.

(✓) Switch the DISPLAY switch to the 9 x 9 position.

NOTE: There should be ten color bars displayed on the screen. Normally you will only see eight or nine bars due to overscan of the TV receiver. With ten color bars, the third bar from the left should appear red, the sixth bar should appear blue, the ninth bar should appear blue-green, and the tenth bar should appear green.

( ) Rotate the PATTERN switch to each of its seven positions. The patterns indicated in Figure 3A (fold-out from Page 42) should appear on the receiver screen.

( ) Set the DISPLAY switch to the 3 x 3 position, and again rotate the PATTERN switch through each of the seven positions. The patterns indicated in Figure 3B (fold-out from Page 42) should appear on the receiver screen. Leave the switch in the COLOR BARS position.

( ) Turn the CHROMA control fully clockwise.

( ) Pull the 4.5 MHz switch to ON, and note the herringbone in the color bar pattern.

( ) Push the 4.5 MHz switch to OFF.

Two methods are provided for checking the video output signals. Method #1 requires an oscilloscope. The clarity and detail of the patterns are directly related to the bandwidth and triggering of the oscilloscope used.

Method #2 requires the Vectorscope to be connected to the video detector and sync detector output of a TV receiver.

If an oscilloscope is available, perform Method #1. If an oscilloscope is not available, perform Method #2.

Method #1

( ) Connect the shielded cable from the Vectorscope to the vertical input of the oscilloscope.

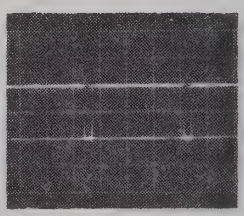
( ) Set the Vectorscope PATTERN switch to PURITY.

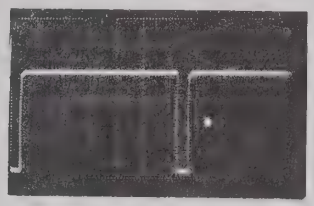
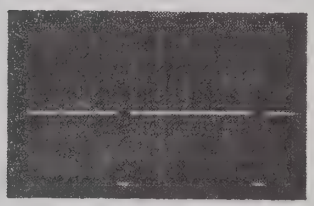
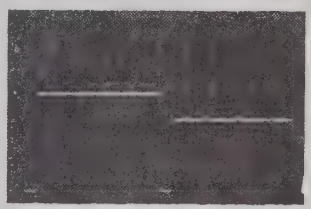
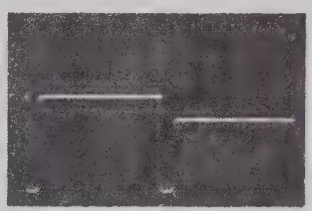
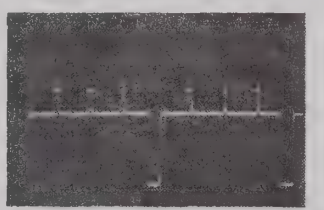
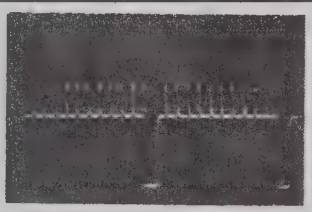
( ) Set the RF-VIDEO switch to VIDEO.

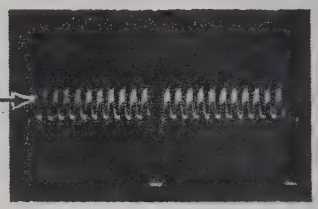
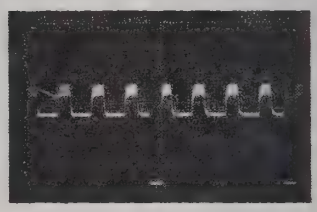
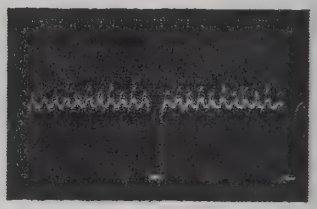
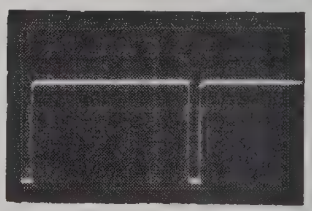
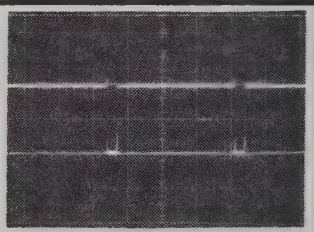
( ) Set the DISPLAY switch to the 3 x 3 position.

( ) Set the Vectorscope VIDEO control fully clockwise.

Perform the checks listed in the following chart.

SET VECTORSCOPE CONTROLS AS FOLLOWS:	SET OSCILLOSCOPE CONTROLS AS FOLLOWS:	OSCILLOSCOPE PATTERN
( ) PATTERN switch to PURITY.	Horizontal sweep to 1/2 the vertical sweep rate of the TV receiver (30 Hz).	

SET VECTORSCOPE CONTROLS AS FOLLOWS:	SET OSCILLOSCOPE CONTROLS AS FOLLOWS:	OSCILLOSCOPE PATTERN
( ) PATTERN switch to PURITY.	Horizontal sweep to 1/2 the horizontal sweep rate of the TV receiver (7920 Hz).	
( ) PATTERN switch to DOTS.		
( ) PATTERN switch to CROSS-HATCH.		
( ) PATTERN switch to HORIZ. LINES.		
( ) PATTERN switch to VERT. LINES.		
( ) DISPLAY switch to 9 x 9.		

SET VECTORSCOPE CONTROLS AS FOLLOWS:	SET OSCILLOSCOPE CONTROLS AS FOLLOWS:	OSCILLOSCOPE PATTERN
( ) PATTERN switch to COLOR BAR.	Horizontal sweep to 1/2 the horizontal sweep rate of the TV receiver (7920 Hz).	CHROMA MODULATION 
( ) Vary the CHROMA control and notice the change in chroma modulation on the waveform. Then reset the control to mid-range.		
( ) DISPLAY switch to 3 x 3.		
( ) PATTERN switch to GRAY SCALE. DISPLAY switch to 9 x 9.		
( ) Disconnect the Vectorscope from the oscilloscope. Connect the oscilloscope to the SYNC jack on the Vectorscope front panel.		
	Horizontal sweep to 1/2 the vertical sweep rate of the TV receiver (30 Hz).	

( ) Disconnect the oscilloscope from the Vectorscope.

This completes Method #1.

Method #2

( ) Connect the shielded cable output leads of the Vectorscope to the video detector output of the television receiver.

( ) Connect a wire from the SYNC jack on the Vectorscope front panel to the output of the sync detector in the TV receiver.

( ) Set the RF-VIDEO switch to VIDEO.

Refer to the screen patterns on Figure 3A (fold-out from Page 42) for the following steps.

( ) Place the DISPLAY switch in the 9 x 9 position.

( ) Set the PATTERN switch to PURITY. See pattern #1.

( ) Set the PATTERN switch to DOTS. See pattern #2.

( ) Rotate the VIDEO control through its entire range. The dots should change from black to white. Leave the control in the white dot position.

( ) Set the PATTERN switch to CROSSHATCH. See pattern #3.

( ) Set the PATTERN switch to HORIZ. LINES. See pattern #4.

( ) Set the PATTERN switch to VERT. LINES. See pattern #5.

( ) Set the PATTERN switch to COLOR BARS. See pattern #6.

( ) Set the PATTERN switch to GRAY SCALE. See pattern #7.

( ) Set the DISPLAY switch to the 3 x 3 position.

( ) Set the PATTERN switch to PURITY.

( ) Turn the PATTERN switch through each position again and compare the TV patterns to the patterns shown in Figure 3B.

( ) Disconnect the Vectorscope from the TV receiver.

This completes Method #2.

VECTOR DISPLAY

( ) Set the PATTERN switch to COLOR BARS. A spot should appear on the CRT of the Vectorscope.

NOTE: To make the following focus and astigmatism adjustments, remove the knobs from the HORIZ. POSITION and VERT. POSITION controls; then insert a small screwdriver in the hollow shaft of each control.

( ) Adjust the FOCUS and ASTIGMATISM controls for the smallest round spot.

( ) Replace the knobs on the HORIZ. POSITION and VERT. POSITION controls.

( ) Rotate the VERT. POSITION back and forth. The spot should move vertically between 3 and 9 on the CRT. If necessary, loosen the CRT clamp and rotate the CRT. Then retighten the CRT clamp.

( ) Rotate the HORIZ. POSITION control back and forth. The spot should move horizontally across the CRT.

( ) Position the spot in the center of the CRT screen.

WARNING: To avoid the danger of shock, turn off your television receiver before proceeding to the next step. The alligator clips at the end of the 4-wire cable will be connected to your receiver in the following steps. If you are not sure of the proper connection points in your receiver, refer to the schematic diagram and the picture tube basing chart. The alligator clips are identified by their wire colors.

NOTE: Before connecting the 4-wire cable in the next step, determine whether the chroma signal is fed to the grid or cathode of the TV receiver picture tube.

( ) Place the CHROMA switch (located on the rear panel) in the CATH. position for cathode fed receivers or in the GRID position for grid fed receivers.

( ) Connect the Vectorscope chroma leads (4-wire cable) to the chroma leads of the TV receiver as follows.

RED to the red chroma signal lead.
BLUE to the blue chroma signal lead.
GREEN to the green chroma signal lead.
BLACK to chassis ground.

NOTE: The luminance (black and white) signal must be bypassed to ground on TV receivers that have their chroma signals applied to the cathodes of the picture tube. Some TV receivers have a service switch which grounds the luminance signal when the switch is in the raster position. If there is no service switch, the luminance signal must be bypassed with an electrolytic capacitor. This capacitor should be between 5 μF and 15 μF, and it should have a voltage rating of at least 50 volts. Connect this capacitor between the center lug of the contrast control and chassis ground. It is also a good idea to turn the contrast control to minimum.

( ) Connect the Vectorscope shielded cable to the antenna terminals of the TV receiver.

( ) Turn on the TV receiver.

( ) Tune in the color bars on an unused channel of the TV receiver. A pattern in the form of a daisy or petal will be displayed on the Vectorscope.

Perform the next six steps only if the TV receiver has the chroma signals applied to the grids of the picture tube.

( ) Place the RED GUN switch in the SHORT position. The red color should disappear from the TV screen.

( ) Return the RED GUN switch to the NORMAL position.

( ) Place the BLUE GUN switch in the SHORT position. The blue color should disappear from the TV screen.

( ) Return the BLUE GUN switch to the NORMAL position.

( ) Place the GREEN GUN switch in the SHORT position. The green color should disappear from the TV screen.

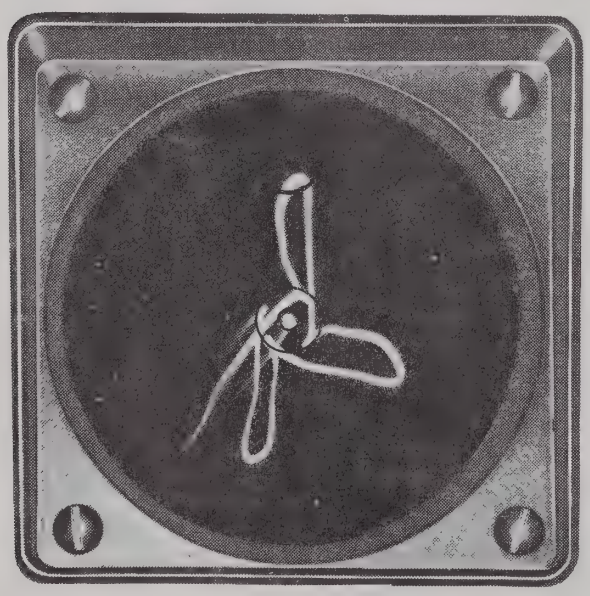
( ) Return the GREEN GUN switch to the NORMAL position.

NOTE: In the following steps, both the Vectorscope and TV receiver controls will be adjusted to produce a petal pattern on the Vectorscope. The CHANNEL, CHROMA, and RF controls of the Vectorscope affect the size and shape of the petal pattern. The color, tint, and horizontal hold control of the TV receiver also affects the size and shape of the pattern.

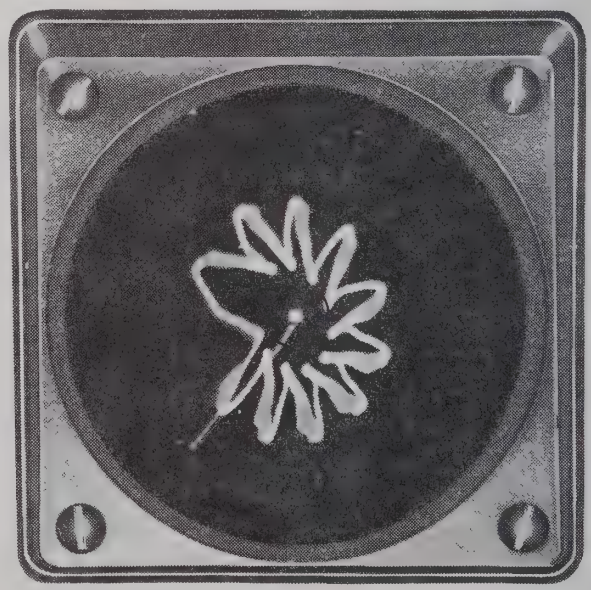
( ) Adjust these controls for a pattern like that shown in Figure 4 for grid-fed picture tubes or Figure 5 for cathode-fed picture tubes.

( ) Disconnect the shielded cable leads from the TV receiver.

( ) Connect a VHF antenna to the TV receiver.

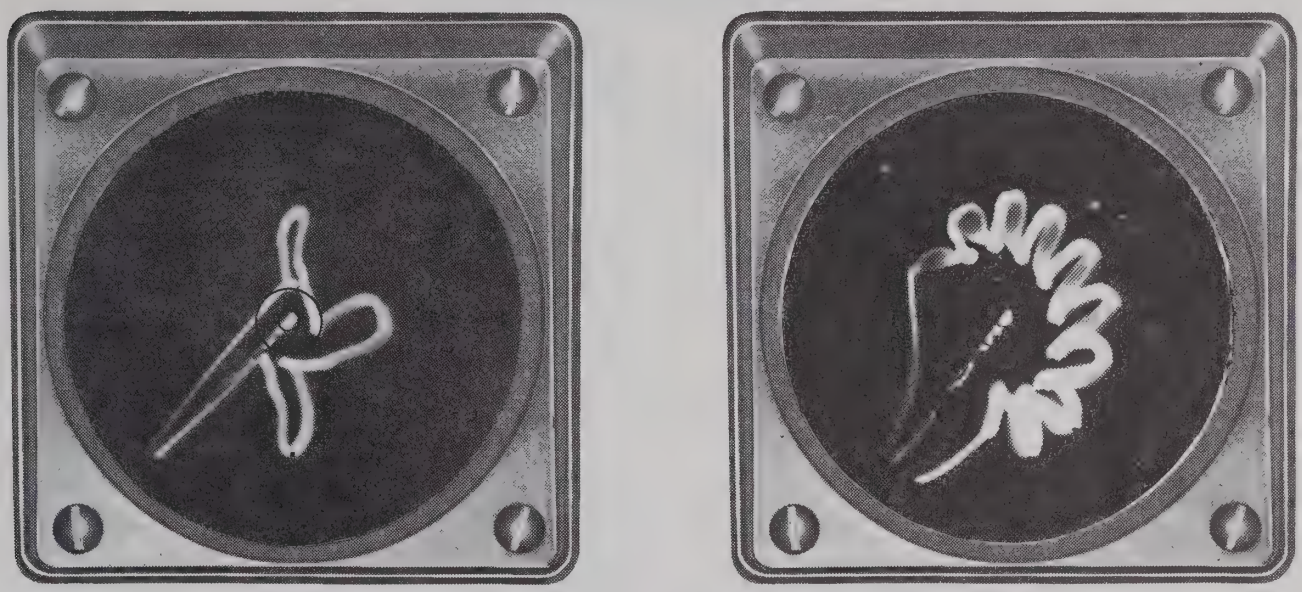


3 X 3



9 X 9

Figure 4



3 X 3 9 X 9

Figure 5

( ) Tune in a color broadcast on one of the higher channels (4, 5, or 6) if possible.

( ) Set the TINT control to the center of its rotation.

( ) Disable the burst amplifier by removing the burst amplifier tube. NOTE: On transistorized TV receivers, remove the burst amplifier transistor and disable the color killer.

( ) Adjust the reactance coil for the most stable color picture. The entire picture will be predominately one color and not bars of color. Also, the Vectorscope pattern should spin or rotate very slowly.

( ) Remove the VHF antenna from the TV receiver.

( ) Connect the Vectorscope shielded cable to the antenna terminals on the TV receiver.

( ) Tune the Vectorscope to the same channel as the TV receiver. The pattern displayed on the Vectorscope will spin or rotate.

( ) Adjust the 3.56 MHz oscillator adjust trimmer capacitor, C13 (see Figure 1) until the pattern stops or rotates very slowly. This locks the Vectorscope color oscillator to the TV receiver. The color oscillator in the TV receiver was previously adjusted to the transmitted signal.

( ) Reinstall the burst amplifier tube. NOTE: On transistorized receivers, reinstall the burst amplifier transistor and turn on the color killer circuit.

( ) The Vectorscope pattern should stop spinning.

This completes the "Test and Adjustments" section.

FINAL ASSEMBLY

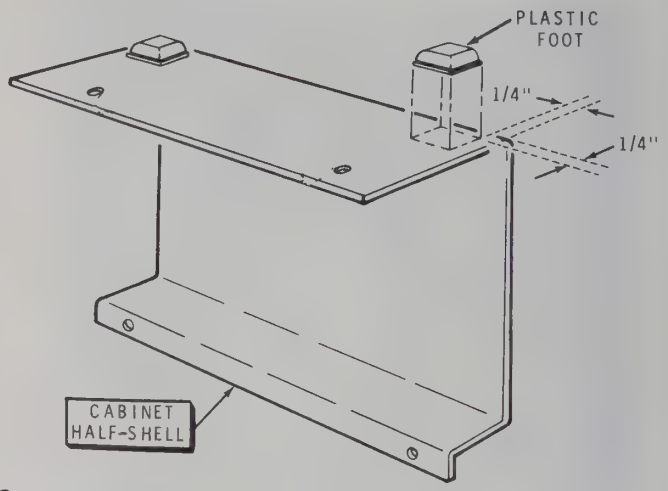
Refer to Pictorial 26 for the following steps.

( ) Remove the backing paper from two plastic feet. Install the feet on the bottom side of one cabinet half-shell at the indicated locations.

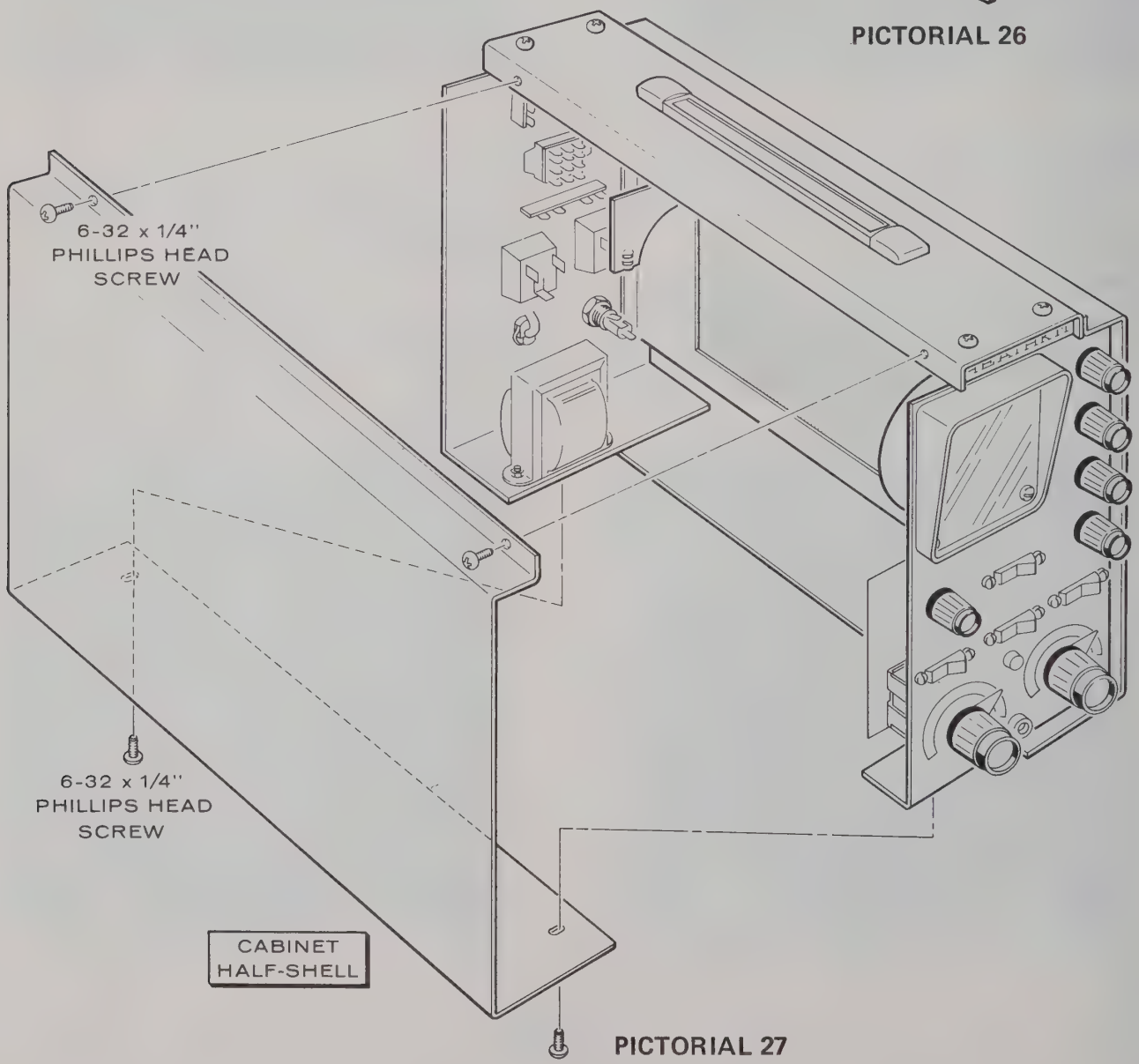
( ) Similarly, install two plastic feet on the other cabinet half-shell.

Refer to Pictorial 27 for the following steps.

( ) Mount both cabinet halves to the chassis with 6-32 x 1/4" phillips head screws as shown.



PICTORIAL 26



PICTORIAL 27

OPERATION

The "Test and Adjustments" section of this Manual introduced you to the operation of your Vectorscope. This section will help you obtain the greatest use of your instrument by directing you through the adjustments of a typical color television receiver.

The best procedure for TV receiver adjustments and servicing is normally provided by the TV receiver manufacturer. However, since all color or black and white TV receivers operate on the same principles, follow the procedure presented in this section of the Manual if manufacturer's recommendations are not available.

To effectively and properly use the Vectorscope, it is necessary to know the correct pattern display of an aligned TV receiver. It is suggested that the Vectorscope be connected to a properly aligned TV receiver and the shape and amplitude of the pattern (vector display) be closely examined. Place a "tape flag" on an alignment tool so that you can return each coil to its original position, then you can proceed to misalign each coil and transformer called out in the "Color Circuit Adjustment" section and note the effect it has on the Vectorscope pattern. Try this method on several TV receivers. You will notice only a slight difference in the final display of each TV receiver, and you will obtain a "feel" for a properly aligned TV receiver.

Figure 6 (fold-out from Page 73) shows the front and rear panels of the Vectorscope. Study the figure carefully to identify the function of each switch, control, jack, and socket.

The following notes will help you use the Vectorscope effectively.

NOTES:

1. In some of the following steps you will be directed to "turn on" and "turn off" designated color guns in the picture tube. Color guns in TV receivers that apply the chroma signals to the grids can be turned on or off with the gun switches on the front panel of the Vectorscope. In TV receivers that have the chroma signals applied to the cathodes, the guns can be turned off by turning down the screen (drive) controls. Use the procedure that pertains to the type of TV receiver under test.

2. As a general rule the 3 x 3 display on any pattern is preferred for centering, linearity, and static convergence adjustments. A 9 x 9 display is preferred for dynamic convergence and an overall check of the sweep circuits. It is suggested that the display switch be tried in both positions to determine individual preference.

3. Keep the brightness control at a relatively low level when dot patterns are being used. This will keep the dots smaller in size and sharper in detail, making them easier to converge.

4. When tuning the Vectorscope to the TV receiver, always set the PATTERN switch to COLOR BARS; then start at the lower end of the band and tune clockwise. The first clockwise position that produces a color bar display on the TV screen is the correct position.

SETUP PROCEDURE

1. Turn off the AFT (Automatic Fine Tuning) switch and any other automatic tuning feature on TV receivers that have these features.

2. Tune the TV receiver to a color broadcast station between channels 2 and 6. Do not change the setting of the fine tuning control once the channel is properly tuned in.

3. Disconnect the VHF antenna from the TV receiver.

WARNING: To avoid a possible electrical shock, always turn off the TV receiver before you connect or disconnect any leads to internal parts of the TV receiver.

4. Connect the Vectorscope shielded leads to the TV receiver antenna terminals.

5. Place the CHROMA switch located on the rear panel of the Vectorscope in the appropriate position, depending on whether the chrominance signal of the TV receiver is applied to the cathodes or the grids of the picture tube.

6. Connect the Vectorscope chroma leads (4-wire cable) to the chroma leads of the TV receiver as follows:

   RED to the red chroma signal lead.
   BLUE to the blue chroma signal lead.
   GREEN to the green chroma signal lead.
   BLACK to chassis ground.

7. Set the PATTERN switch to COLOR BARS and turn on the Vectorscope.

8. Turn on the TV receiver.

9. Tune the Vectorscope to the receiver. Remember to tune for color on the low side of the channel.

RASTER ADJUSTMENTS

1. Set the PATTERN switch to CROSSHATCH.

2. Set the DISPLAY switch to the 3 x 3 position.

3. For TV receivers with vertical and horizontal centering controls, adjust these controls to center the crosshatch pattern on the screen.

4. Adjust the vertical linearity and height controls for uniform rectangles from the top to the bottom of the screen.

5. If the TV receiver contains a horizontal efficiency or width control, make any necessary adjustments.

6. For TV receivers with retangular picture tubes, refer to the manufacturer's service data for the correct sequence for adjusting the pincushion controls to produce straight lines at the extreme top, bottom, and sides of the screen.

STATIC CONVERGENCE ADJUSTMENTS

The purpose of the static convergence adjustments is to converge the red, green, and blue dots to produce white dots in the middle of the screen. The static convergence magnets are effective only in the center area of the picture tube as shown in Figure 7. The dots in the other areas of the screen are converged by the "Dynamic Convergence Adjustments."

Usually the static convergence must be performed before and after the "Purity Adjustments," because a certain amount of interaction will occur between the two.

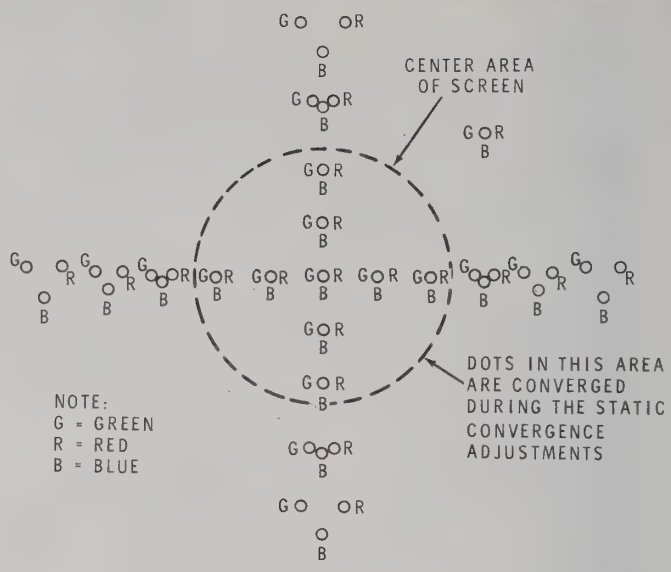


Figure 7

1. Completely degauss the picture tube and the metal parts around the tube.

2. Connect and tune the Vectorscope to the TV receiver as instructed in the "Setup Procedure" before proceeding.

3. Set the PATTERN switch to DOTS.

4. Turn off the blue gun.

5. Refer to Figure 8 for the directions that the color dots will move when the static convergence magnets are adjusted.

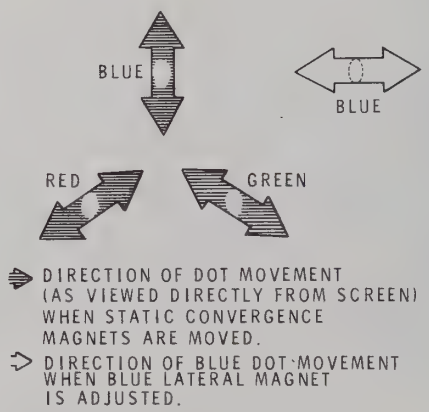


Figure 8

6. Adjust the red and green static convergence magnets to converge the dots in the center area of the picture tube screen into a pure yellow dot.

7. Turn on the blue gun.

8. Adjust the blue static magnet and the blue lateral magnet so that the blue converges with the yellow to obtain a white dot in the center area of the screen.

9. If a red or green edge appears at one edge of the white dot, turn the blue gun off and touch up the convergence of the red and green dot as necessary. Then turn on the blue gun and recheck the white dot.

NOTE: Some red may show around the edges of the dots, because the red dots are slightly larger than the blue and green dots.

10. Without disturbing the Vectorscope/TV receiver setup, continue to the "Purity Adjustments" that follow.

PURITY ADJUSTMENTS

The purpose of the purity adjustments is to align the electron beams in order that the red beam strikes only the red phosphor dots, the green beam strikes only the green phosphor dots, and the blue beam strikes only the blue phosphor dots as the screen of the picture tube is scanned. This will remove impure color areas from the screen. See Figure 9.

NOTE: If after performing the next step, the picture tube appears all red, the purity does not require adjustment. Therefore, disregard the following steps and proceed to "Gray Scale Adjustments."

1. Turn off the green and blue guns.

2. Loosen the deflection yoke and move it straight back as far as it will go in the yoke mount. Use extreme care not to shift the angular position of the yoke.

3. Adjust the purity rings to produce an approximately uniform red spot in the center portion of the picture tube screen. Do not be concerned with the outside edges of the screen.

4. When the spot is centered on the screen, slowly move the yoke a small amount forward toward the face of the tube to make the red area larger. Alternately adjust the yoke and purity rings until the entire screen is filled with a uniform, pure red color.

5. Set the PATTERN switch to HORIZ. LINES.

6. Check the screen to be sure the yoke has not shifted position. Then retighten the deflection yoke.

7. Turn off the red gun and turn on the green gun; then check the purity of the green screen.

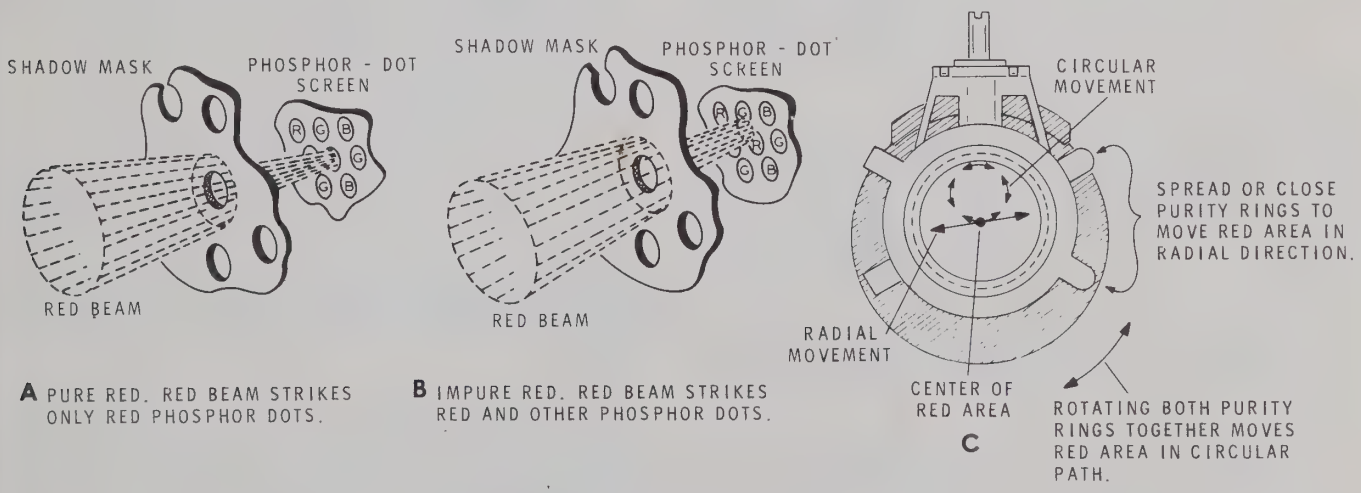


Figure 9

8. Turn off the green gun and turn on the blue gun; then check the purity of the blue screen.

NOTE: Readjust the red purity if the green and blue purity is not good.

9. Turn on all three guns.

10. Set the PATTERN switch of the Vectorscope to DOTS and check the static convergence. Touch up the static convergence after the purity adjustments are completed.

GRAY SCALE ADJUSTMENTS

The purpose of these adjustments is to remove any predominant color shade that might appear in a black and white picture.

1. Connect and tune the Vectorscope to the TV receiver as instructed in the "Setup Procedure" before proceeding.

2. Set the PATTERN switch to PURITY.

3. Turn the contrast and color controls on the TV receiver to minimum.

4. Adjust the brightness control of the TV receiver for a faint raster (faint light on the screen).

5. Set the kine bias switch (or control) to the minimum brightness position and the drive controls to minimum. Then set the red, green, and blue screen controls to minimum.

NOTE: If any one of the screen controls cannot produce the specified faint color raster, advance the kine bias switch to its next position. Leave the bias switch in the lowest position that permits proper adjustment of all screen controls.

6. Advance the red screen control to produce a faint red raster.

7. Advance the green control to produce a faint yellow raster.

8. Advance the blue screen control to produce a faint white raster.

9. Set the PATTERN switch to GRAY SCALE.

10. Observe the highlights and lowlights of the pattern. A tint in the highlights can be corrected by adjusting the proper drive controls. A tint in the lowlights can be corrected by adjusting the proper screen controls. The various shaded bars should have a brightness value but no color.

DYNAMIC CONVERGENCE ADJUSTMENTS

The purpose of the dynamic convergence adjustment is to converge the red, green, and blue dots into white dots in areas away from the center of the screen.

NOTE: On TV receivers that have pincushion adjustments, be sure to check these adjustments before going through "Dynamic Convergence." Do not try to obtain perfect convergence at all corners of the screen, since in most cases this cannot be realized, especially in sets without pincushion adjustments. Careful examination of any color TV receiver will show slight misconvergences, especially near the corners of the picture. When all dots appear as pure white at a normal viewing distance (at least five feet away), the convergence is considered satisfactory.

A typical convergence control panel is shown in Figure 10. The areas of the picture tube screen affected by the various dynamic convergence controls are also shown in this figure.

VERTICAL DYNAMIC CONVERGENCE

1. Connect and tune the Vectorscope to the TV receiver as instructed in the "Setup Procedure" before proceeding.

2. Turn off the blue gun.

3. Set the DISPLAY switch to the 9 x 9 position.

NOTE: The convergence control board is divided into four rows of controls and coils. The two rows at the bottom converge the vertical center line in areas 1 and 2 on the picture tube screen. The two rows at the top converge the horizontal center line in areas 3 and 4 of the screen. Refer to Figure 10.

Only the center vertical row of dots will be adjusted in areas 1 and 2 in the following steps. Since a certain amount of interaction will occur between the controls, it will be necessary to repeat the next two steps several times before the dots become converged in both areas.

4. Adjust control A and control D to move the red and green dots closer together in area 1 and area 2.

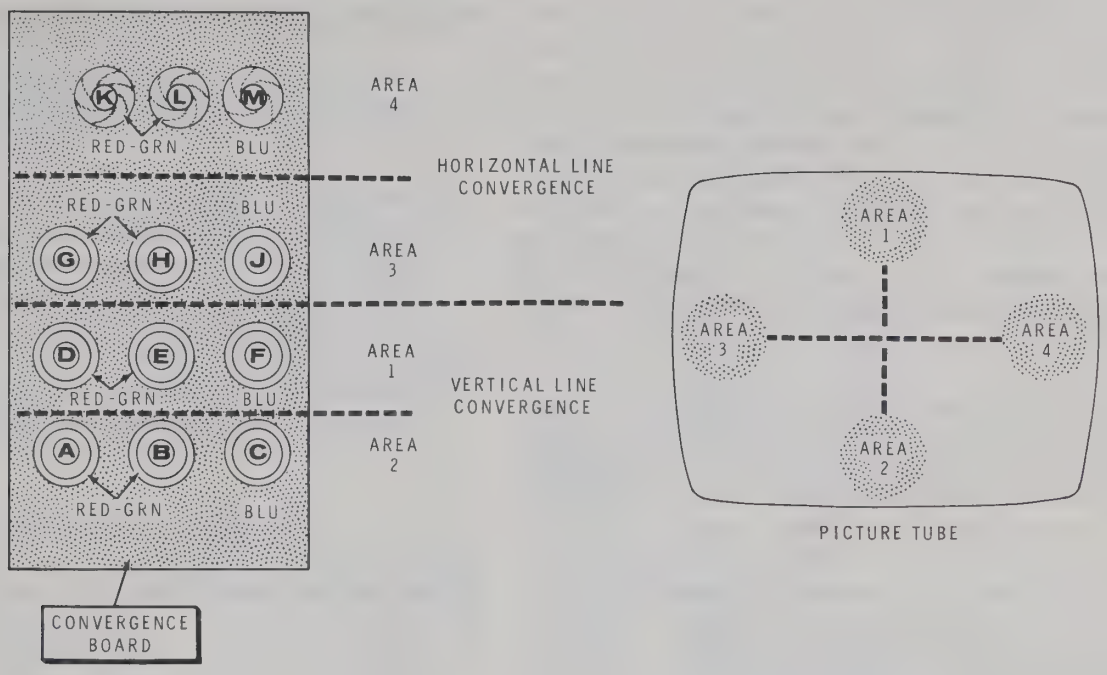


Figure 10

5. Adjust control B and control E to converge the red dots and green dots into yellow dots in area 1 and area 2.

6. Check all of the dots in the vertical line in areas 1 and 2. Make sure that all red and green dots are merged together to form pure yellow dots. If the dots near the center of the screen are not properly converged, readjust the red and green static convergence magnets; then repeat the previous two steps.

7. Turn on the blue gun.

8. Merge the blue dots with the yellow dots to make white dots in area 1 and area 2, by adjusting controls C and F.

9. Check all the dots in the center vertical row to make sure they are all white. If the blue dots at the center of the screen are not properly converged, readjust the blue static convergence magnet and the blue lateral magnet; then repeat the previous step.

This completes convergence of the vertical center row of dots.

HORIZONTAL DYNAMIC CONVERGENCE

1. Figure 10 shows the area where each horizontal convergence control or coil is most effective. Refer to this Figure to see which dots each control or coil will move. Also note which way the dots will move.

2. Turn off the blue gun.

NOTE: To overcome the interaction between the controls, repeat the next two steps as many times as necessary until the dots are merged at both locations. The coil adjustments are not as responsive as the controls adjusted previously. Two or three turns of each coil may be necessary to cause noticeable dot movement.

3. Adjust controls G and H to converge the red and green dots in area 3 on the picture tube.

4. Adjust coils K and L to converge the red and green dots in area 4 on the picture tube.

5. Turn on the blue gun.

6. Merge the blue dots with the yellow dots at areas 3 and 4 by adjusting coil M and control J.

This completes the "Convergence Adjustments."

COLOR CIRCUIT ADJUSTMENTS

To correctly display color on the screen, the color detector circuits of the TV receiver must be synchronized (the same frequency and phase angle) with the transmitted color subcarrier. For this reason a 3.58 MHz color burst signal is included in the transmitted TV signal as a reference. The 3.58 MHz oscillator in the color-sync section of the TV receiver generates a signal which is compared with the transmitted reference burst signal and is automatically locked in with the burst signal.

NOTE: The luminance (black and white) signal must be bypassed to ground in TV receivers that have their chroma signals applied to the cathodes of the picture tube. Some TV receivers have a service switch which grounds the luminance signal when the switch is in the raster position. If there is no raster switch, the luminance signal must be bypassed with a 10 μF 50 V electrolytic capacitor. This capacitor should be between 5 μF and 15 μF, and it should have a voltage rating of at least 50 volts. Connect this capacitor between the center of the contrast control and ground. It is also a good idea to turn the contrast control to minimum.

3.58 MHz Oscillator Adjustment

1. Connect and tune the Vectorscope to the TV receiver as instructed in the "Setup Procedure."

2. Adjust the 3.58 MHz oscillator in the TV receiver for maximum amplitude of the vector display.

Reactance Coil Adjustment

1. Connect and tune the Vectorscope to the TV receiver as instructed in the "Setup Procedure."

2. Disable the reactance stage of the receiver. To do this, remove the burst amplifier tube in tube sets, or the burst amplifier transistor in transistorized sets.

3. Disable the color killer circuit. The vector display may rotate or spin rapidly.

4. Carefully adjust the reactance coil until the vector display stops rotating.

5. Place the reactance stage and the color killer back in operation.

Phase Detector Transformer Adjustment

1. Connect and tune the Vectorscope to the TV receiver as instructed in the "Setup Procedure."

2. Rotate the tint control from its fully counterclockwise position to its clockwise position. The third petal of the 9 x 9 vector display (the first petal of the 3 x 3 display) should move an equal distance on each side of the R-Y circle.

3. Adjust the phase detector transformer so that the third petal moves an equal distance on each side of the R-Y circle.

Demodulation Angle Check

1. Connect and tune the Vectorscope to the TV receiver as instructed in the "Setup Procedure."

2. Adjust the tint control to position the third petal of the 9 x 9 vector display (the first petal of the 3 x 3 display) in the R-Y circle.

3. Observe the sixth petal of the 9 x 9 display (the second petal of the 3 x 3 display) and estimate the number of degrees it is from the R-Y circle. Compare your estimate with the manufacturer's specifications.

NOTE: The marks on the graticule are 30 degrees apart.

Chroma Bandpass Adjustment

NOTE: The chroma bandpass adjustments are "touch-up" adjustments only. Do not attempt these adjustments unless you are familiar with the vector display of a properly aligned TV receiver of the same type.

Keep in mind the following points:

1. Proper bandpass results in a particular shape of the vector display.

2. Subnormal bandwidth increases the petal width.

3. Curvature in the petal sides is due to different R-Y and B-Y signals.

4. Amplitude of the petals is directly proportional to the gain of the chroma circuits.

Be sure the third petal of the 9 x 9 vector display (the first petal of the 3 x 3 display) is positioned in the R-Y circle.

1. Adjust the bandpass transformer and coil to obtain the proper vector display.

PRINCIPLES OF COLOR TV

A knowledge of basic color television theory will help you to make the best use of your Vectorscope. This section of the Manual is intended to refresh your understanding of the principles of color TV.

The Heathkit Vectorscope provides stable test signals for servicing black and white as well as color receivers. All output signals from the Vectorscope may be used for both types of receivers; however, the color bar patterns will appear as black and white bars on a black and white receiver.

Except for the additional circuitry required for color reception, the two types of receivers are basically the same. Therefore, your understanding of black and white receiver servicing can be readily applied to color servicing. To fully utilize the many features of this Vectorscope, a knowledge of the circuits and terms peculiar to color receivers is also desirable. Some basic discussions of these circuits and terms are provided in this section. Further information may often be obtained from local educational institutions who can suggest books or courses covering these subjects.

LIGHT

The visible portion of light is located between infrared and ultraviolet in the electromagnetic spectrum. The visible light spectrum may be broken into the following sequence of colors: red, orange, yellow, green, blue, and violet. All other colors are a combination (in various proportions) of two or more of these colors. The combination of all of the colors in the proper proportion will produce white light. It has been established experimentally that the combination of only three colors (red, green, and blue) in the proper proportion will also produce white light. Combining these three primary "primary colors" in different combinations and proportions will produce a variety of other colors. Color television is based on this combining characteristic of the three primary colors.

Light has three distinct characteristics. The amount of energy reaching the eye is called brightness. The wavelength of the energy within the light spectrum is called hue or color. The quantity or pureness of the hue is called saturation. Colored light has all three characteristics: brightness, hue, and saturation. White light has only brightness.

COLOR TV SIGNAL

In order to faithfully reproduce a color picture, the color signal must contain information about all three light characteristics. The luminance signal (commonly referred to as the "Y" signal) contains all the information pertaining to the brightness of the picture. The chrominance signal contains all information pertaining to hue and saturation of the signal.

The color television camera is composed of three separate image tubes. The red tube sees only red and red components of the other colors. In the same way, the green tube sees only green, and the blue tube sees only blue. The relative intensity of the colors is also picked up by the camera. The output signal from the camera thus contains both the necessary luminance and chrominance information.

TELEVISION PICTURE TUBES

The black and white picture tube displays only various shades of white light. The hue and saturation of the three basic colors are fixed by the phosphor screen of the tube. Brightness is controlled by varying the amount of electrons that strike the screen. Thus, only one electron gun, producing one electron beam, is required in a black and white picture tube.

The color television picture tube displays color as well as white light at various levels of brightness, hue and saturation. A separate electron gun is required for each of the three primary colors. White light is produced by mixing the primary colors in the proper proportion. As in the black and white tube, the electron beam controls only brightness. The color is produced on the phosphor screen of the picture tube.

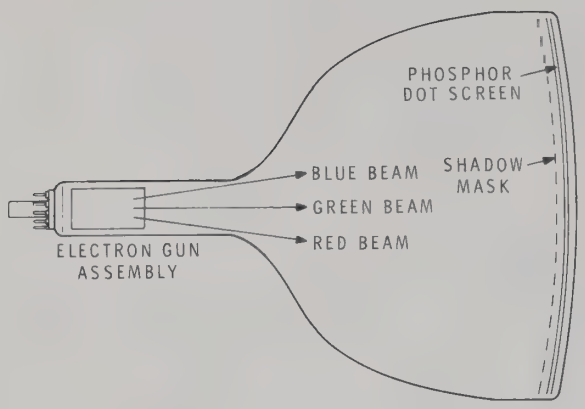


Figure 11

The three main parts of the color picture tube are the phosphor dot screen, shadow mask, and three electron gun assemblies. See Figure 11. The phosphor screen has three different types of phosphors placed in minute triangular dot patterns called triads. The dots are placed very close together but do not touch each other. See Figure 12. Each dot in each triad glows a different primary color when struck by an electron beam.

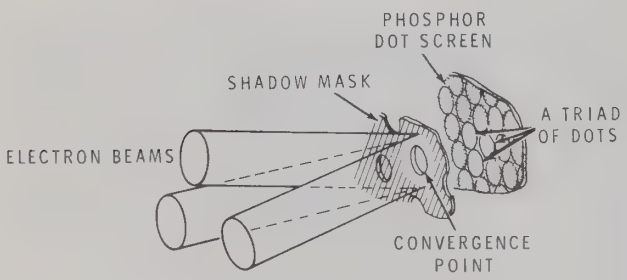


Figure 12

The human eye cannot distinguish the separate dots in a triad at normal viewing distance. The eye blends the three light emissions to give the appearance of a single color. For example, when the light outputs of a triad of dots are in the proper proportion to produce white light, each dot glows with its respective color, but the eye blends them together so that the screen will appear to be white. By controlling the saturation of the dots, it is possible to produce a variety of colors.

Each electron beam must be made to strike its respective dot in a triad as the line is scanned. A shadow mask is placed between the electron guns and the screen for this purpose. The shadow mask is a thin sheet of metal that has been etched with a series of small holes. These holes are positioned so that each one is aligned with a triad of dots. The electron beams from the three guns must converge at a hole in the shadow mask so that each beam strikes only its respective color dot as the beams are scanned across the screen.

By varying the intensity of all three beams simultaneously, the brightness of the triad can be controlled. In addition, the intensity of each electron beam can be individually controlled to emphasize one or more dots and thus produce all desired colors.

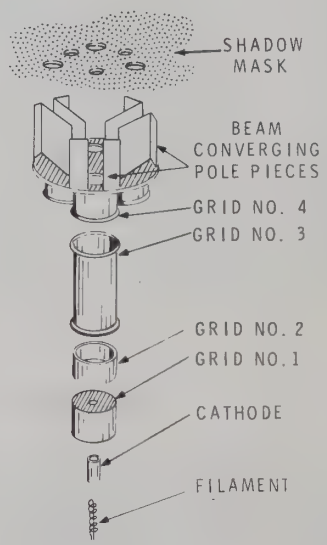


Figure 13

The red, green, and blue electron guns are equally spaced 120 degrees apart around the center axis of the gun assembly. The three guns are identical; and each contains a filament, cathode, #1 grid (control), #2 grid (accelerating anode), #3 grid (focus electrode) and a #4 grid. The #4 grid is a high voltage anode which is connected to the shadow mask and the inside coating of the tube. See Figure 13.

The brightness of the picture is determined by the luminance component of the color TV signal; color is determined by the chrominance component. The luminance component of the signal is applied to the picture tube cathodes and furnishes a controlling voltage to all three beams simultaneously; thus controlling illumination of the screen. The chrominance component of the signal is applied to the control grids of the picture tube to produce the desired color on the screen. See Figure 14.

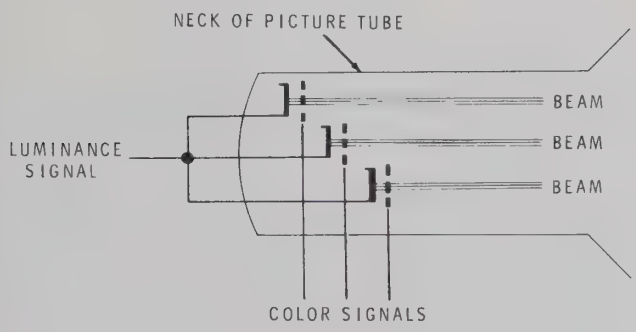


Figure 14

The absence of a chrominance signal produces a black and white picture, because the controlling voltages for all three beams are provided in the proper proportions by the luminance signal. With no color signal applied to the control grids, the beams will be controlled by the luminance signal only, making a black and white picture. Black and white TV sets use only the luminance signal which is the sum of the brightness contained in all three color signals. The color transmitting system is therefore compatible with either black and white or color TV sets.

The physical relationship of the electron beams, shadow mask, and phosphor screen is critical. Very close tolerances are used during manufacture of the tube, but some variations still exist. To compensate for these variations, static magnetic beam controls are mounted outside the neck of the picture tube. See Figure 15. The purpose of these magnetic beam controls is to regulate purity.

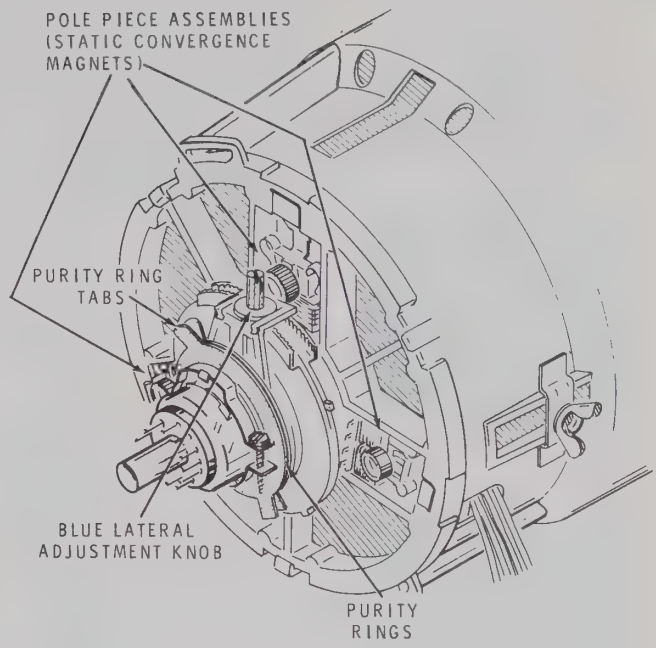


Figure 15

PURITY

The uniformity of the brightness and hue of each of the three primary additive colors is called Purity. If two of the electron guns are biased off as the screen is scanned, the remaining gun will produce a pure red, green, or blue raster as the electron beam strikes only its own color phosphor dots. The term purity describes the color quality of these individual rasters. For example, when the red raster is a uniform red, with no contamination from blue or green, the red field of the picture tube is properly adjusted.

The purity magnet and the deflection yoke are used to properly adjust the picture tube for purity.

The purity magnet consists of two magnetic rings. Each ring has a north and south pole and can be individually rotated 360 degrees. With unlike poles adjacent to each other, no appreciable magnetic field exists. When one ring is rotated, the magnetic field increases in strength and becomes strongest when like poles are adjacent to each other.

The field produced by the purity magnets is uniform and exerts an equal force on all three beams. Depending on the relative position of both rings, the force exerted by the field can position the three beams vertically, horizontally or anywhere between the two axes.

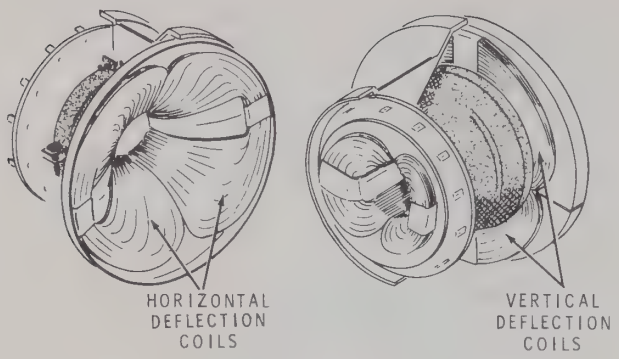


Figure 16

The purity magnets affect purity adjustment in the center of the screen only. The position of the deflection yoke is used to achieve purity around the edges of the screen. The deflection yoke consists of two different pairs of coils. These coils are positioned perpendicular to each other and are shaped to fit over the neck of the tube. See Figure 16. When current is applied through the deflection yoke coils, a magnetic field is formed between them. This field varies in strength and direction in proportion to the current applied to the coils. The field exerts an equal force on all three beams and deflects them vertically and horizontally across the screen.

The physical position of the yoke on the neck of the tube is critical. If the yoke is positioned improperly, the angle of deflection will be changed and the beams may strike the wrong color dots which distorts color purity. The error will be especially noticeable around the outer edges of the screen.

CONVERGENCE

All three electron beams must be aimed at the same hole in the shadow mask at the same instant for the beams to converge on the proper triad of dots. The travel of the individual beams can be corrected by static and dynamic magnetic fields to accomplish convergence.

STATIC CONVERGENCE

A beam positioning pole piece assembly is mounted over each gun. Each magnet provides a field that will move the beam of its gun toward or away from the center axis of the picture tube. The magnets are adjustable. Static magnetic beam controls are mounted outside the neck of the tube to control the amount of deflection. The lateral correction magnet provides a magnetic field to move the blue beam in a horizontal direction.

DYNAMIC CONVERGENCE

The static convergence magnets are effective in the center of the screen but cannot compensate for the curvature of the screen. To accurately control convergence at the edges of the screen, a vertical and horizontal coil are mounted over a horseshoe shaped magnet located in the pole piece assemblies over each gun. An AC signal, in step with the horizontal and vertical sweep signals, is applied to each coil to produce a magnetic field. This field corrects the direction of the beams before the field of the deflection yoke acts upon them.

IN CASE OF DIFFICULTY

This section of the Manual is divided into three parts. The first part, titled "General Troubleshooting Information," describes what to do about any difficulties that may occur right after the kit is assembled.

The second part, titled "Finding the Area of Trouble," describes a method for locating trouble in the divider chain, IC's, or gates.

The third part, a "Troubleshooting Chart," is provided to assist in servicing if the general information does not clear up the problem, or if difficulties occur after the instrument has been in operation for some time. This chart lists a number of possible difficulties that could arise, and lists several possible causes.

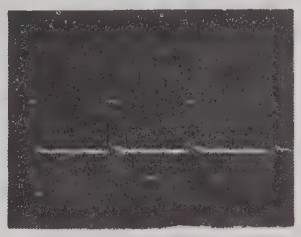
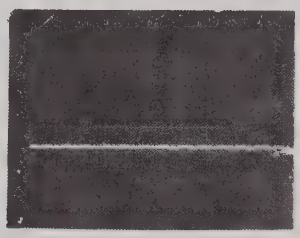
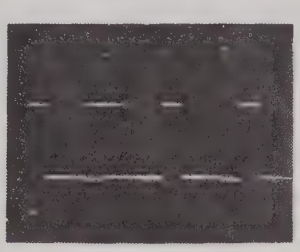
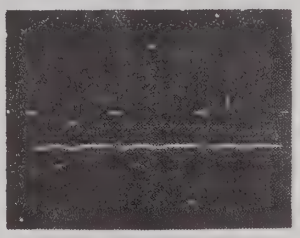
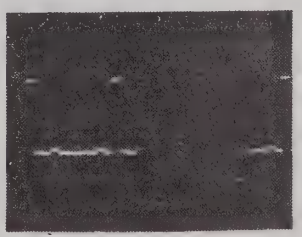
Before starting any troubleshooting procedure, try to narrow the problem down to a specific area by trying the various functions of the instrument.

GENERAL TROUBLESHOOTING INFORMATION

The following paragraphs deal with the types of difficulties that may show up right after a kit is assembled. These difficulties are most likely to be caused by assembly errors or faulty soldering. These checks will help you locate any error of this type that might have been made.

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

AL CHART (cont'd.)

FREQUENCY AND TEST POINTS	OSCILLOSCOPE CONTROL SETTINGS		WAVEFORMS
	VERTICAL	HORZ.	
G2 Gate output pin #5 of IC-9	1 V/Div	20 μ Sec/Div	
G3 Gate output pin #3 and #14 of IC-9	1 V/Div	2 m Sec/Div	 9 x 9 DISPLAY
G4 Gate output pin #8 of IC-10	1 V/Div	5 m Sec/Div	
G5 Gate output pin #3 of IC-10	1 V/Div	5 m Sec./Div.	
G6 Gate output pins #5 and #14 of IC-10	1 V/Div	5 m Sec/Div	

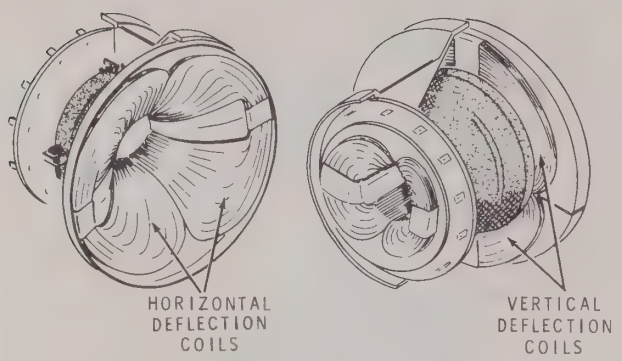


Figure 16

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Before starting any troubleshooting procedure, try to narrow the problem down to a specific area by trying the various functions of the instrument.

GENERAL TROUBLESHOOTING INFORMATION

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1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as described in the Soldering section of the "Kit Builders Guide."

3. Check to be sure that all transistors are in their proper locations. Make sure each transistor lead is connected to the proper point.

4. Check that each of the IC pins are properly installed in their connectors, and not bent out or under the IC. Also be sure the IC's are installed in their correct sockets.

5. Check the values of the parts. Be sure that the proper part has been wired into the circuit as shown in the pictorial diagrams and called out in the wiring instructions.

6. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring. Check for solder bridges between circuit board foils. Compare your foil pattern against the X-Ray Views (fold-out from Page 75). Be particularly watchful of the foil area around the IC sockets for solder bridges.

7. If after careful checks, the trouble is still not located and a voltmeter is available, check the voltage readings against those shown on the Schematic Diagram. NOTE: All voltage readings were taken with an 11 megohm input voltmeter. Voltages may vary as much as ±20%.

8. A review of the Circuit Description may also help you determine where to look for the trouble.

9. NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty sections of the "Kit Builders Guide" and to the "Factory Repair Service" information on Page 64 of this Manual.

FINDING THE AREA OF TROUBLE

Refer to the Block Diagram (fold-out from Page 74) and the Schematic Diagram (fold-out from Page 83) when making the following checks. The Block Diagram shows the signal path and the Schematic shows the pin numbers of the IC inputs and outputs.

Divider Chain

The complete divider chain can be checked by connecting an oscilloscope to the Vectorscope SYNC jack. There should be a 15.84 kHz signal and a 60 Hz signal present at this jack.

If 15.84 kHz is not present, this would indicate something wrong with Q1, Q2, FF3 through FF6, G2, Q5, or G1.

If 15.84 kHz is present but the 60 Hz signal is not, this would indicate something wrong with FF7 through FF15, G6, Q12, G5, or G1.

IC's

To check an IC, connect the oscilloscope to the trigger input (T) of the IC and check for the presence of a signal. If no signal is present, check the Q and $\overline{Q}$ (not Q) output of the previous IC. An IC that has no output but does have an input would indicate that the IC is faulty.

Refer to the Divider Chain Signal Chart (Page 61) for the correct oscilloscope display. An incorrect display could be caused by a defective IC, an intermittent connection, or a bent IC pin. To check the IC, interchange it with a known good IC from an earlier stage.

Gates

A signal is required at all of the inputs of gates G2, G3, G4, G5, and G6 to receive a signal at the output. A signal at either input of gate G1 should produce a signal at the output. If there is no signal at the input of a gate, or if the signal differs from that shown on the Divider Chain Signal Chart, it would indicate that there is a break in the signal path between the divider chain output and the gate input. Again, this could be caused by an intermittent connection or a bent IC pin.

To check the gate, interchange it with a known good IC gate.

DIVIDER CHAIN SIGNAL CHART

FREQUENCY AND TEST POINTS	OSCILLOSCOPE CONTROL SETTINGS		WAVEFORMS
	VERTICAL	HORIZ.	
190.08 kHz FF1 T pin #6 of IC-1 FF2 T pin #2 of IC-1 FF3 T pin #6 of IC-2	.5 V/Div	5 μ Sec/Div	
$\frac{190.08\text{ kHz}}{3}$ = 63.36 kHz FF1 Q pin #9 of IC-1 FF2 Q pin #13 of IC-1	.5 V/Div	5 μ Sec/Div	
$\frac{190.08\text{ kHz}}{2}$ = 95.04 kHz FF3 Q pin #9 of IC-2 FF4 T pin #2 of IC-2	.5 V/Div	5 μ Sec/Div	
$\frac{95.04\text{ kHz}}{2}$ = 47.52 kHz FF4 $\overline{Q}$ pin #14 of IC-2 FF5 T pin #6 of IC-3 FF6 T pin #2 of IC-3	.5 V/Div	5 μ Sec/Div	
$\frac{47.52\text{ kHz}}{3}$ = 15.84 kHz FF5 Q pin #9 of IC-3 FF6 Q pin #13 of IC-3	.5 V/Div	20 μ Sec/Div	

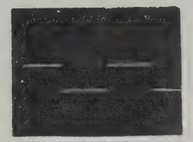
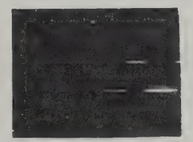
FREQUENCY AND TEST POINTS	OSCILLOSCOPE CONTROL SETTINGS		WAVEFORMS
	VERTICAL	HORIZ.	
$\frac{47.52\text{ kHz}}{3}$ = 15.84 kHz FF7 T pin #6 of IC-4 FF6 Q pin #14 of IC-3	.5 V/Div	20 μ Sec/Div	
$\frac{15.84\text{ kHz}}{2}$ = 7.92 kHz FF7 Q pin #9 of IC-4 FF8 T pin #2 of IC-4	.5 V/Div	20 μ Sec/Div	
$\frac{7.92\text{ kHz}}{2}$ = 3.96 kHz FF8 Q pin #13 of IC-4 FF9 T pin #6 of IC-5	.5 V/Div	50 μ Sec/Div	
$\frac{3.96\text{ kHz}}{2}$ = 1.98 kHz FF9 Q pin #9 of IC-5 FF10 T pin #2 of IC-5 FF11 T pin #6 of IC-6	.5 V/Div	100 μ Sec/Div	
$\frac{1.98\text{ kHz}}{3}$ = 660 Hz FF10 Q pin #13 of IC-5 FF11 Q pin #9 of IC-6 FF12 T pin #2 of IC-6	.5 V/Div	500 μ Sec/Div	

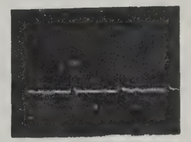
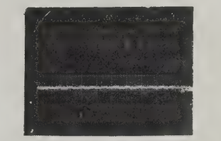
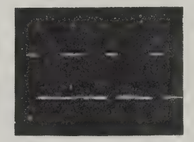
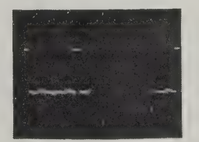
Troubleshooting Chart

DIFFICULTY	POSSIBLE CAUSE
Neither pilot lamp nor CRT filaments light.	1. Fuse blown. 2. Off-On switch. 3. No AC power from outlet.
Pilot lamp lights, CRT filament does not light.	1. Power transformer.
No spot or trace on CRT.	1. Positioning or intensity controls improperly adjusted. 2. High voltage power supply. 3. CRT.
Dot cannot be centered vertically.	1. Vertical Position control. 2. Resistor R219.
Dot cannot be centered horizontally.	1. Horizontal Position control. 2. Resistor R218.
No vertical deflection (when connected to the TV receiver).	1. Connection not being made to the red gun of the TV receiver. 2. Capacitor C208. 3. Chroma switch.
No horizontal deflection (when connected to the TV receiver).	1. Connection not being made to the blue gun of the TV receiver. 2. Capacitor C207. 3. Chroma switch.
Poor focus.	1. Paper backing not removed from graticule. 2. CRT. 3. Focus control. 4. Astigmatism control. 5. Resistors R217, R221, or R222.
Trace acts erratic when the graticule is touched.	1. Clean the graticule with detergent to eliminate static charge.
Dot remains on CRT in all positions of PATTERN switch.	1. Transistor Q13. 2. CRT.
Tunes some but not all channels 2 through 6.	1. C107 misadjusted.

DIFFICULTY	POSSIBLE CAUSE
Weak or no RF signal output.	1. RF Level control set too low. 2. Transistor Q11 or associated components.
RF but no video output.	1. Pattern switch in Purity position. 2. Pattern switch incorrectly wired. 3. Diode D5. 4. Transistors Q7, Q8, or Q9, Q10.
Video but no sync.	1. Gate G1. 2. Transistor Q7. 3. Integrated circuits or solder short on circuit board.
No color bars.	1. Chroma Level control turned counter-clockwise. 2. Capacitor C16. 3. Transistor Q6. 4. 3.56 MHz crystal.
Color rainbow but no color bars.	1. Diode D5. 2. Transistor Q9. 3. Pattern switch incorrectly wired. 4. No keying pulse to Q9. 5. Display switch between 3 x 3 and 9 x 9 position.
No vertical bars, dots, or crosshatch.	1. Transistor Q3. 2. Capacitor C5 misadjusted.
No horizontal lines, dots or crosshatch.	1. NAND gate G3 or G4.
No 4.5 MHz signal.	1. Transistor Q4 shorted. 2. 4.5 MHz crystal.
Guns will not short.	1. Clips connected to cathodes of cathode-fed receiver. 2. Ground wire on 4-wire cable not connected. 3. Clip not touching control grid wires. 4. Clip on wrong control grid wire.

DIVIDER CHAIN SIGNAL CHART (cont'd.)

FREQUENCY AND TEST POINTS	OSCILLOSCOPE CONTROL SETTINGS		WAVEFORMS
	VERTICAL	HORZ.	
333.33 Hz FF12 Q pin #13 of IC-6 FF13 T pin #6 of IC-7	.5 V/Div	500 μ Sec/Div	
166.67 Hz FF13 Q pin #9 of IC-7 FF14 T pin #2 of IC-7	.5 V/Div	2 m Sec/Div	
60 Hz FF14 Q pin #13 of IC-7 FF15 T pin #2 of IC-8	.5 V/Div	5 m Sec/Div	
60 Hz FF15 $\overline{Q}$ pin #5 of IC-8	.5 V/Div	5 m Sec/Div	
G1 Gate output pin #8 of IC-9	1 V/Div	5 m Sec/Div	

FREQUENCY AND TEST POINTS	OSCILLOSCOPE CONTROL SETTINGS		WAVEFORMS
	VERTICAL	HORZ.	
G2 Gate output pin #5 of IC-9	1 V/Div	20 μ Sec/Div	
G3 Gate output pin #3 and #14 of IC-9	1 V/Div	2 m Sec/Div	 9 x 9 DISPLAY
G4 Gate output pin #8 of IC-10	1 V/Div	5 m Sec/Div	
G5 Gate output pin #3 of IC-10	1 V/Div	5 m Sec./Div.	
G6 Gate output pins #5 and #14 of IC-10	1 V/Div	5 m Sec/Div	

Troubleshooting Chart

DIFFICULTY	POSSIBLE CAUSE
Neither pilot lamp nor CRT filaments light.	1. Fuse blown. 2. Off-On switch. 3. No AC power from outlet.
Pilot lamp lights, CRT filament does not light.	1. Power transformer.
No spot or trace on CRT.	1. Positioning or intensity controls improperly adjusted. 2. High voltage power supply. 3. CRT.
Dot cannot be centered vertically.	1. Vertical Position control. 2. Resistor R219.
Dot cannot be centered horizontally.	1. Horizontal Position control. 2. Resistor R218.
No vertical deflection (when connected to the TV receiver).	1. Connection not being made to the red gun of the TV receiver. 2. Capacitor C208. 3. Chroma switch.
No horizontal deflection (when connected to the TV receiver).	1. Connection not being made to the blue gun of the TV receiver. 2. Capacitor C207. 3. Chroma switch.
Poor focus.	1. Paper backing not removed from graticule. 2. CRT. 3. Focus control. 4. Astigmatism control. 5. Resistors R217, R221, or R222.
Trace acts erratic when the graticule is touched.	1. Clean the graticule with detergent to eliminate static charge.
Dot remains on CRT in all positions of PATTERN switch.	1. Transistor Q13. 2. CRT.
Tunes some but not all channels 2 through 6.	1. C107 misadjusted.

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RF but no video output.	1. Pattern switch in Purity position. 2. Pattern switch incorrectly wired. 3. Diode D5. 4. Transistors Q7, Q8, or Q9, Q10.
Video but no sync.	1. Gate G1. 2. Transistor Q7. 3. Integrated circuits or solder short on circuit board.
No color bars.	1. Chroma Level control turned counter-clockwise. 2. Capacitor C16. 3. Transistor Q6. 4. 3.56 MHz crystal.
Color rainbow but no color bars.	1. Diode D5. 2. Transistor Q9. 3. Pattern switch incorrectly wired. 4. No keying pulse to Q9. 5. Display switch between 3 x 3 and 9 x 9 position.
No vertical bars, dots, or crosshatch.	1. Transistor Q3. 2. Capacitor C5 misadjusted.
No horizontal lines, dots or crosshatch.	1. NAND gate G3 or G4.
No 4.5 MHz signal.	1. Transistor Q4 shorted. 2. 4.5 MHz crystal.
Guns will not short.	1. Clips connected to cathodes of cathode-fed receiver. 2. Ground wire on 4-wire cable not connected. 3. Clip not touching control grid wires. 4. Clip on wrong control grid wire.

FACTORY REPAIR SERVICE

You can return your completed kit to the Heath Company Service Department to have it repaired for a minimum service fee. (Kits that have been modified will not be accepted for repair.) If you wish, you can deliver your kit to a nearby Heath Authorized Service Center. These centers are listed in your Heathkit catalog.

To be eligible for replacement parts under the terms of the warranty, equipment returned for factory repair service, or delivered to a Heath Authorized Service Center, must be accompanied by the invoice or the sales slip, or a copy of either. If you send the original invoice or sales slip, it will be returned to you.

If it is not convenient to deliver your kit to a Heath Authorized Service Center, please ship it to the factory at Benton Harbor, Michigan and follow the following shipping instructions:

Prepare a letter in duplicate, containing the following information:

- Your name and return address.
- Date of purchase.
- A brief description of the difficulty.
- The invoice or sales slip, or a copy of either.
- Your authorization to ship the repaired unit back to you C.O.D. for the service and shipping charges, plus the cost of parts not covered by the warranty.

Attach the envelope containing one copy of this letter directly to the unit before packaging, so that we do not overlook this important information. Send the second copy of the letter by separate mail to Heath Company, Attention: Service Department, Benton Harbor, Michigan.

Check the equipment to see that all parts and screws are in place. (Do not include wooden cabinets when shipping receivers, tuners, amplifiers, or TV sets, as these are easily damaged in shipment.) Then, wrap the equipment in heavy paper. Place the equipment in a strong carton, and put at least THREE INCHES of resilient packing material (shredded paper, excelsior, etc.) on all sides, between the equipment and the carton. Seal the carton with gummed paper tape, and tie it with a strong cord. Ship it by prepaid express, United Parcel Service, or insured parcel post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

SPECIFICATIONS

PATTERNS

Purity	Produces a snow-free raster for purity adjustments.
Dots*	9 x 9 produces a display of 110 small dots. 3 x 3 produces a display of nine dots for convergence adjustments.
Crosshatch*	9 x 9 produces a display of 11 vertical and 10 horizontal lines. 3 x 3 produces a display of three vertical and three horizontal lines for convergence and linearity adjustments.

*The number of dots, lines, and bars indicated for a 9 x 9 display is the number displayed if the receiver under test has no overscan.

Horizontal Lines*	9 x 9 produces a display of 10 horizontal lines. 3 x 3 produces a display of three horizontal lines for vertical linearity and pin-cushion adjustments.
Vertical Lines*	9 x 9 produces 11 vertical lines. 3 x 3 produces a display of 3 vertical lines for horizontal linearity and convergence adjustments.
Color Bars*	9 x 9 produces a display of ten standard color bars. 3 x 3 produces a display of three standard color bars. A visual fingerprint (voltage pattern) of all ten color bars in the form of a petal pattern is displayed for color circuit servicing.
Gray Scale	Provides a wide bar crosshatch pattern with six shades of brightness for color gun level adjustments.

OUTPUT SIGNALS

Video	Greater than ±1 volt peak-to-peak composite signal for composite signal injection beyond the video detector.
RF	Variable to approximately 25,000 μV output, channels 2 through 6, for composite signal injection into the TV receiver antenna input terminals.
Sync	Greater than 3.5 volts peak-to-peak signal for servicing sync circuits without video, or sets having separate video and sync demodulator phase adjustments.

GENERAL

Power Requirements	105-125 or 210-250 VAC, 50/60 Hz, 20 Watts.
Cabinet Dimensions	6-3/4" wide x 9-1/4" high x 14-1/2" deep.
Net Weight	9-1/2 lbs.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate features in instruments previously sold.

*The number of dots, lines, and bars indicated for a 9 x 9 display is the number displayed if the receiver under test has no overscan.

THEORY OF OPERATION

This part of the Manual is divided into four parts. The first part will describe the function of various stages in the Vectorscope. It will briefly outline the production of each pattern that is selected by the Pattern switch. The second part will explain flip-flops. Gates will be explained in the third part, and the fourth part will explain composite signals. Refer to the Block Diagram (fold-out from Page 74) while you read this Theory of Operation.

CIRCUIT OPERATION

The Heathkit Model IO-101 Vectorscope uses combinations of logic circuits to provide the several output patterns. A stable sine wave signal is generated by a master clock oscillator. This signal is shaped by succeeding stages and proceeds to a divider chain that consists of a series of flip-flop circuits. The flip-flops divide the frequency of the master clock signal. At various points in the divider chain, signals of desired frequency are picked off and applied to other logic circuits consisting of AND, NAND, NOR, or OR gates. These circuits, in turn, combine the proper signals to produce the desired output patterns.

MASTER CLOCK AND DIVIDER CHAIN

The master clock oscillator generates the primary signal from which all other signals in the timing circuit are obtained. To provide accurate timing signals, the output of the master clock oscillator must be very stable. This is accomplished by the use of a crystal-controlled Pierce oscillator which generates a 190.08 kHz signal.

The divider chain driver circuit shapes the 190.08 kHz sine wave signal into a square wave signal. This signal is then divided to provide the needed signals to the gate circuits and output switching circuits.

PATTERN CIRCUITS

Signals from various gate circuits, driver and shaper circuits, and crystal-controlled oscillators are coupled to the Pattern selector switch. Each position of the Pattern switch selects the signal of the proper frequency and shape to produce the pattern desired.

Vertical Lines

The output signal of the master clock oscillator and divider chain driver passes through the clipper-shaper stage which differentiates the waveform. This results in a pulse which shows up as a narrow vertical line on the TV screen. This pulse is combined with the sync signal in the sync/video circuit. The combination results in the required number of pulses per horizontal sweep duration; these pulses, in turn, produce the desired number of vertical lines.

Horizontal Lines

The output signal from the divider chain is fed to a NAND gate. This results in a pulse which produces a narrow horizontal line on the TV screen. This pulse signal is combined with the sync signal in the sync/video circuit. The combination results in the required number of pulses per vertical sweep duration.

Crosshatch

The horizontal line and vertical line signals are combined in an OR gate. Both the vertical and horizontal signals from the output of the OR gate produce the vertical and horizontal lines on the screen in a crosshatch pattern.

Dots

An AND gate combines the vertical and horizontal signals to produce a dot pattern. Since both signals must be present to produce an output, this condition exists only when the vertical and horizontal lines cross. Thus, horizontal and vertical rows of dots are produced.

Gray Scale

The gray scale pattern is produced by combining pulses to form the vertical and horizontal bars in a wide bar crosshatch pattern. The half cycle in each direction will superimpose every other bar to display a change in shade.

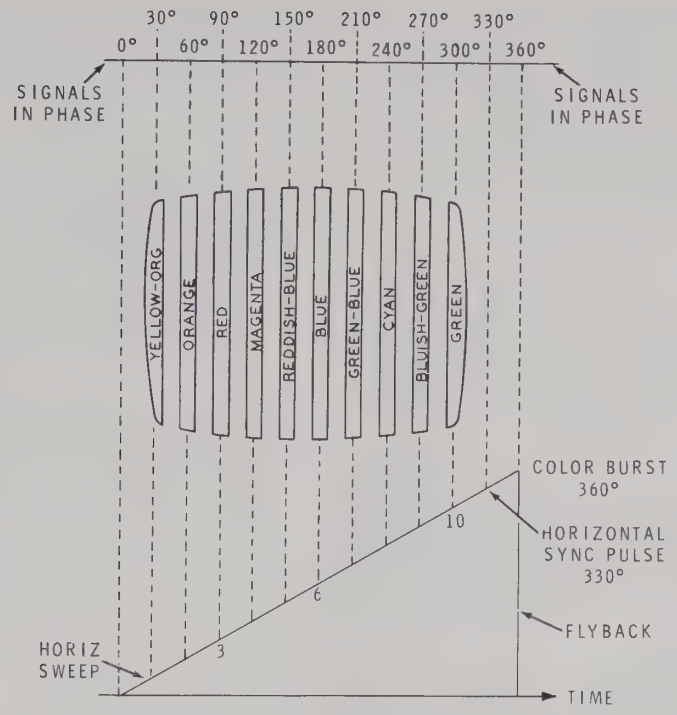


Figure 17

Color Bars

A color signal is required to trigger and synchronize the color oscillator in a television receiver. This color signal is produced by an oscillator circuit in the Vectorscope which is adjusted to one horizontal line frequency below the color oscillator of the receiver. Thus, the two signals are in phase once during each horizontal blanking pulse, but are out of phase during each horizontal scanning line. See Figure 17. This slow change in phase difference produces an even-blending rainblow of colors on the television screen. The rainbow is divided into color bars as the color bar blanker is keyed on and off. The eleventh and twelfth bars are blanked out by the horizontal blanking pulse.

Purity

Only the composite vertical and horizontal sync signal is required to produce the clear raster needed to make purity adjustments in a receiver. Therefore, none of the pattern-producing signals are coupled into the video amplifier circuit. Three color gun-killer switches are provided to bias off the grids of each gun in the picture tube so that the purity of each color can be checked and adjusted.

3 x 3 or 9 x 9 DISPLAY

The 63.36 kHz signal from FF1, FF2, and the 180 Hz signal from gate G4 are combined to produce the 3 x 3 display signal. The 190.08 kHz signal from Q2 and the 660 Hz signal from FF11 are combined to produce the 9 x 9 display signal.

4.5 MHz OSCILLATOR

During color presentation, the sound carrier oscillator signal in the Vectorscope will beat with the color carrier signal in the TV receiver and appear as a herringbone pattern in the color bars. When the receiver tuner is properly adjusted, the IF sound trap will attenuate the herringbone. This provides an accurate means of tuning the receiver or adjusting the IF sound trap.

SIGNAL OUTPUT CIRCUITS

The combined vertical and horizontal sync signals and the pattern signal from the video amplifier are combined in the sync/video stages to provide the composite video signal. This composite signal is then coupled to either the video output stage or to the RF oscillator stage, depending upon the position of the Signal switch.

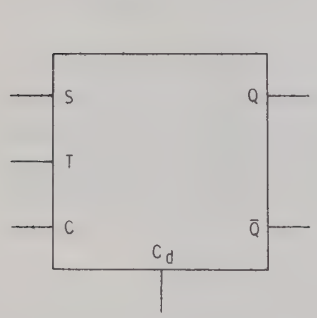
The video output stage supplies the composite video signal from coupling directly into the video circuits of a television receiver. The RF oscillator circuit produces an RF carrier that is tunable through TV channels 2 through 6. The carrier is modulated by the composite video signal and can be coupled to the antenna input terminals of the receiver.

FLIP-FLOPS

The bistable multivibrator, or flip-flop as it is generally called, is basically much like a two-position switch. Flip-flops come in many configurations and with several special features. A popular version with great versatility is the "J-K flip-flop" used in this instrument.

Integrated circuits IC-1 through IC-7 are dual J-K flip-flops, while IC-8 is a single J-K flip-flop. Since the operation of all these flip-flops is the same, the following explanation of a J-K flip-flop applies to all the flip-flops used in this instrument.

Figure 18 illustrates the symbol and truth table for a J-K flip-flop. A J-K flip-flop has two complementary outputs, Q and $\bar{Q}$ (not Q), which will always be at opposite levels. When Q is logic 1, $\bar{Q}$ is logic 0; when Q is logic 0, $\bar{Q}$ is logic 1.



t		
tn		tn+1
S	C	Q
0	0	Qn
0	1	0
1	0	1
1	1	$\bar{Q}$n

Figure 18

The C_d (direct clear) input clears or resets the flip-flops to the logic 0 state, regardless of any inputs applied. When a logic 1 level is applied to C_d, output Q is forced to logic 0 level and $\bar{Q}$ to a logic 1 level. This input has been connected to ground on several of the flip-flops not requiring a C_d input to prevent noise pulses from clearing the flip-flop.

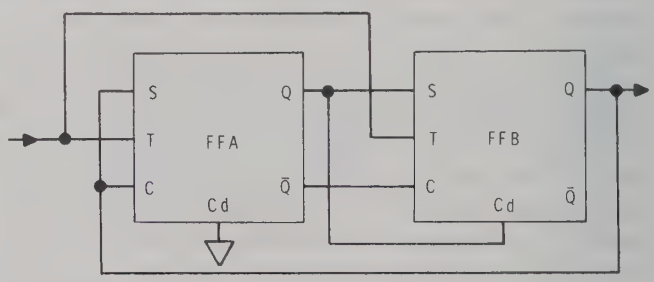
The logic levels applied to control inputs S and C determine the output levels of Q and $\bar{Q}$ only after an adequate clock (or toggle) pulse is applied to input T. Changes in input levels to S and C alone will not produce a change in output levels. A clock pulse applied to input T must be a negative-going pulse (logic 1 to logic 0) with a fast fall time, such as the trailing edge of a square wave. Steady-state logic levels and positive-going pulses (logic 0 to logic 1) will not cause the flip-flops to change states.

The tn+1 column of the truth table in Figure 18 shows the state of the flip-flop coincident with the application of the clock pulse. The term Qn represents the output state of the flip-flop prior to the application of a clock pulse while $\bar{Q}$n represents the output state opposite that which existed prior to the application of the clock pulse.

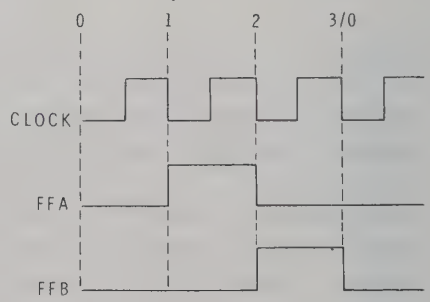
Since the S and C inputs of FF3 are grounded (logic 0), it can be seen from the truth table that the flip-flops will change states each time a clock pulse is applied. The clock (or toggle) signal is obtained from the 190.08 kHz square wave signal applied to input T. Since the flip-flop changes state only when a negative pulse (the trailing edge of the square wave) is applied to input T, it requires two complete input cycles to produce a one-cycle output, hence, a divide-by-two function.

DIVIDE BY THREE

Figure 19 illustrates how two flip-flops are connected to divide by three, their waveform relationships, and a count-sequence chart. Assume both flip-flops to be in a 0 state. Both the S and C inputs of FFA are 0 as they are both connected to the Q output of FFB. Since FFA is in the 0 state, the S input of FFB is at a 0 level and the C input is at a 1 level. The first clock pulse will cause FFA to change to

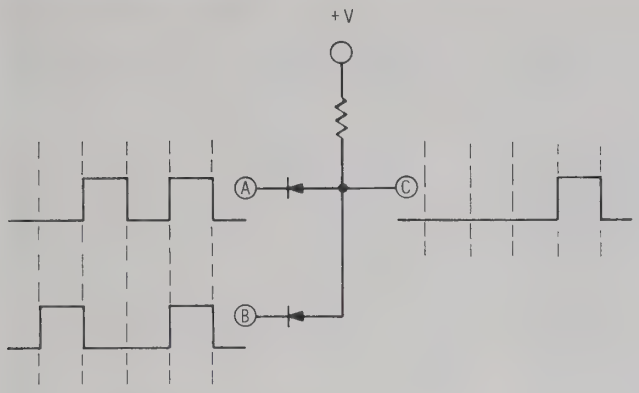


COUNT	FFA	FFB
0	0	0
1	1	0
2	0	1
3/0	0	0



DIVIDE BY THREE

Figure 19

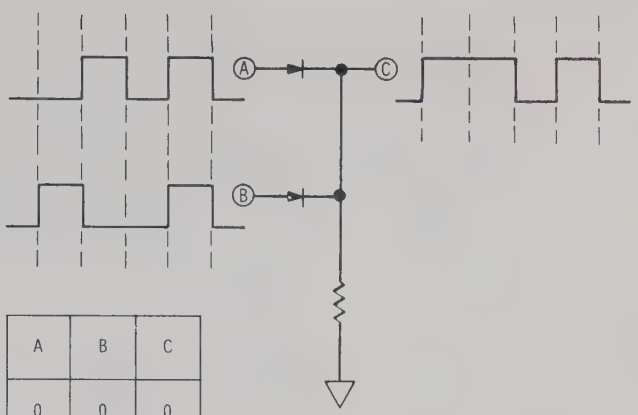


A	B	C
0	0	0
1	0	0
0	1	0
1	1	1

AND GATE

Figure 20

the 1 state, while FFB did not change states. The second clock pulse will cause FFA to change to the 0 state and FFB to change to the 1 state. The inputs to FFA are now at a 1 level and the S and C inputs to FFB are at a 0 and 1 level, respectively. The third clock pulse will cause only FFB to change to the 0 state. It can be seen from the count-sequence chart and the waveforms that three input pulses are required to produce one output pulse from FFB.



A	B	C
0	0	0
1	0	1
0	1	1
1	1	1

OR GATE

Figure 21

GATES

A gate is so named because it allows signals to pass only under controlled conditions. There are four types of gates used in this instrument: AND, OR, NAND, and NOR.

The AND gate, shown in Figure 20, requires that all of its input signals be present (logic 1) before it will produce an output (logic 1).

The OR gate, shown in Figure 21, produces an output (logic 1) when one or the other of its input signals is present (logic 1). Both the AND and the OR gates are diode logic circuits in which diodes are used to perform the logical operations.

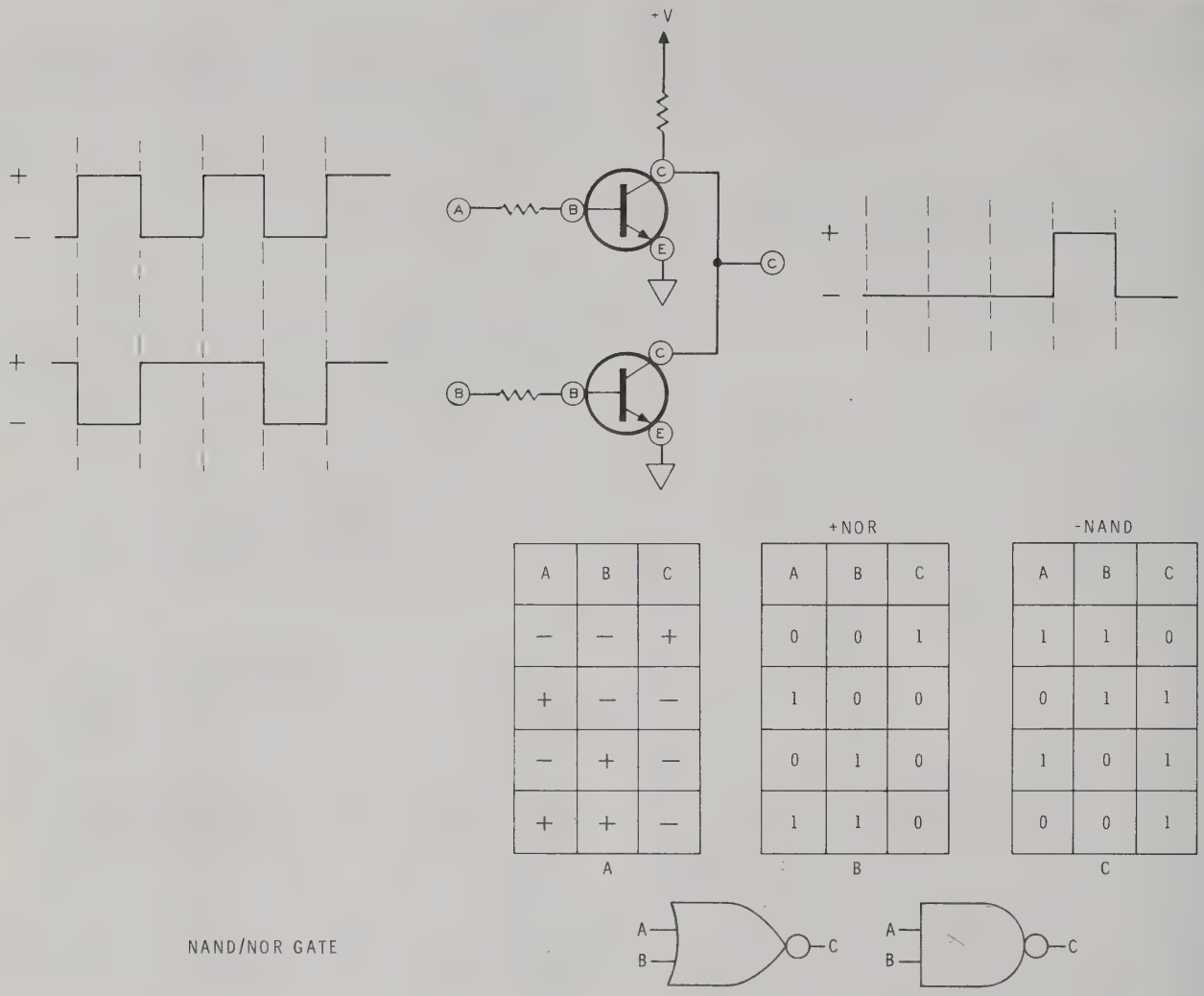


Figure 22

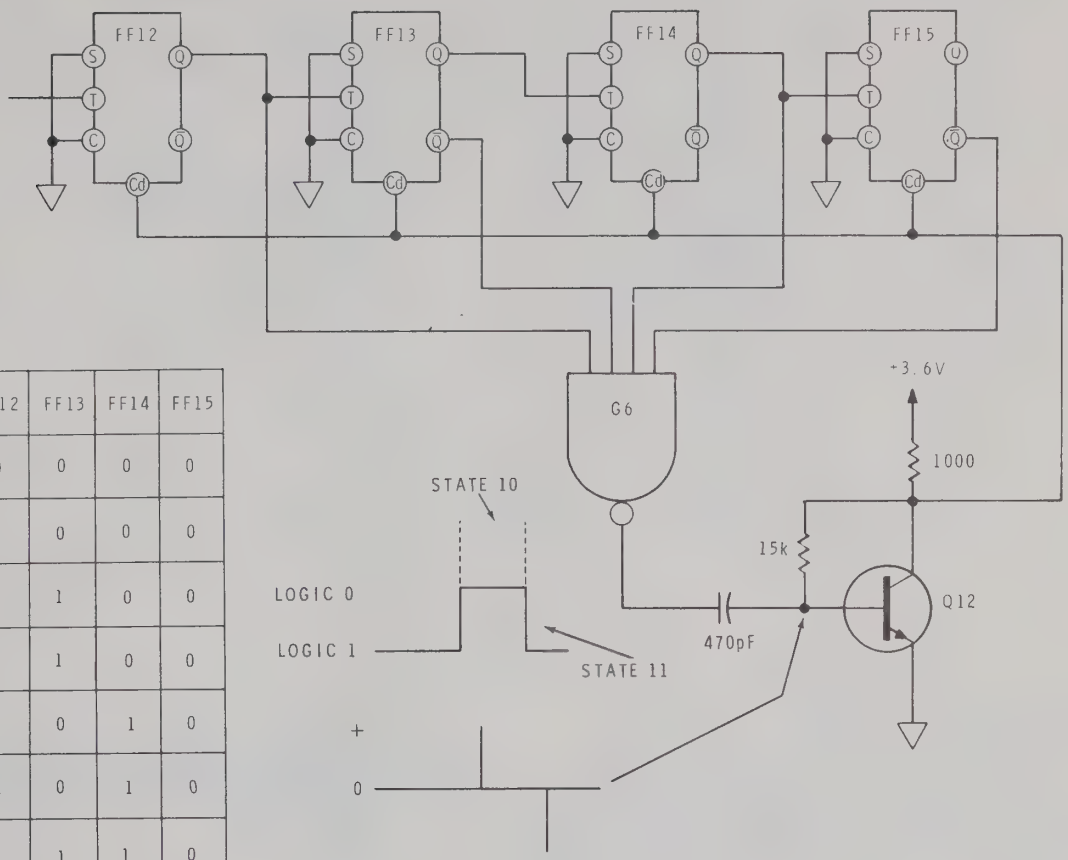
Integrated circuits IC-9 and IC-10 are quadruple 2-input NAND/NOR gates. In the Vectorscope they are used as positive logic NOR gates and as negative logic NAND gates. Figure 22 illustrates the symbols, equivalent circuit, truth tables, and the input/output waveforms for a typical 2-input NAND/NOR gate.

A gate circuit is referred to as a negative logic gate if a logic 1 is used to represent a negative voltage and as a positive logic gate if a logic 1 is used to represent a positive voltage. The circuit in Figure 23 performs the NOR function when positive logic is used as shown in truth table B. Negative logic produces the NAND function as shown in truth table C.

DIVIDE BY ELEVEN

Figure 23 shows how four flip-flops and a NAND gate are connected to divide by eleven. Cascading four flip-flops will produce a circuit which has 16 stable states unless a means of resetting the counter is provided. The circuit shown in Figure 23 will reset (clear) the counter to 0 on the eleventh state, and the count will then begin again.

An output from each flip-flop is connected to one input of the negative logic NAND gate G6. This is a 4-input NAND gate which is formed by connecting two 2-input NAND gates in parallel. During the tenth state of the counter when the Q logic levels of flip-flops FF12, FF13, FF14, and FF15



STATE	FF12	FF13	FF14	FF15
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11/0	0	0	0	0

Figure 23

are 0101 respectively, the inputs to NAND gate G6 are 1111 (negative logic). This results in a positive voltage (logic 0) from G6. The transition from logic 1 to logic 0 is differentiated by the 470 pF, C19, capacitor and the 15 kΩ, R31, resistor producing a positive spike. Since transistor Q12 is biased to saturation, this positive spike will not affect the circuit. The eleventh state of the counter causes FF12 to change states, resulting in a 0111 input to NAND gate G6. This input will return the output of G6 to a logic 1 level. The trailing edge of the pulse, or the transition from logic 0 to logic 1, is also differentiated by the 470 pF C19, capacitor and the 15 kΩ, R31, resistor producing a negative spike. A negative spike will drive Q12 to cutoff placing a positive potential, or logic 1 (positive logic) at the collector and to the C_d (clear) input of each flip-flop. When a logic 1 is applied to the C_d inputs, the Q outputs of each flip-flop are forced to a logic 0 level. During the eleventh state, since all flip-flops are cleared to logic 0, the eleventh and zero states are the same.

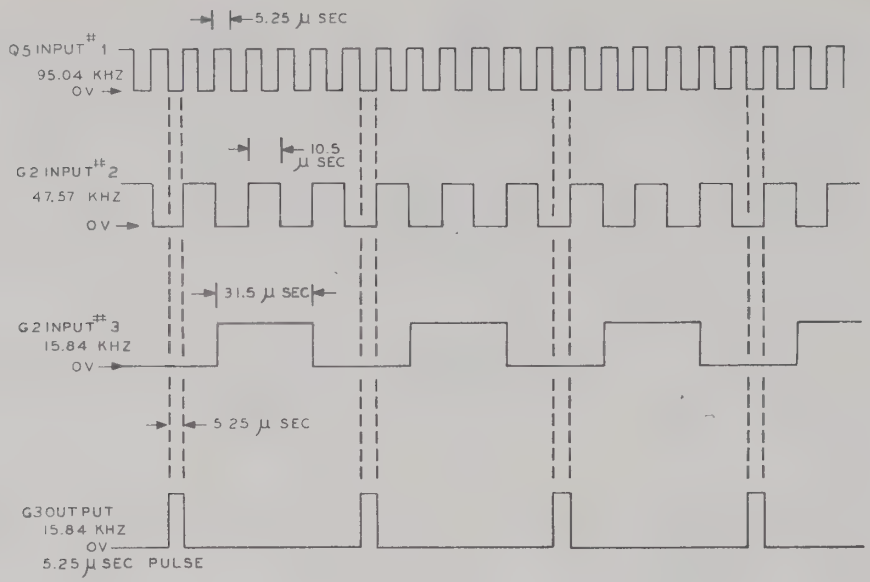


Figure 24

COMPOSITE SYNC SIGNAL

The outputs of FF3, FF4, and FF5-FF6 are fed into the horizontal sync shaper, NAND gate G2 and Q5. Q5 may be considered as one added input to G2, since the outputs are common. When all inputs to G2 and Q5 are at a 0 level, an output signal is produced. This signal remains at the output terminal for the length of time when all the inputs are at the 0 level. Figure 24 shows the time relationship between the input signals at the output of NAND gate G2. The 5.25 μs sync pulse produced is similar to the 5 μs horizontal sync pulse transmitted by the TV station.

Similarly, the outputs of flip-flops FF13 and FF15 are fed into the vertical sync shaper, NAND gate G5, to produce the 60 Hz vertical sync pulse which is 252 μs wide. From their respective sync shapers, the signals are fed to NOR gate G1, where the signals are mixed and form the composite (vertical and horizontal) sync signal appearing at the output of G1.

VECTOR PATTERN

The vector pattern (petal) is composed of two color signals, R-Y (red) and B-Y (blue). These signals are applied to the vertical and horizontal deflection plates of the Vectorscope CRT. The resulting pattern is a lissajous figure.

If two sine waves 90 degrees out of phase, but of the same frequency and amplitude, are applied to the CRT deflection plates, the lissajous figure is a circle. See Figure 25.

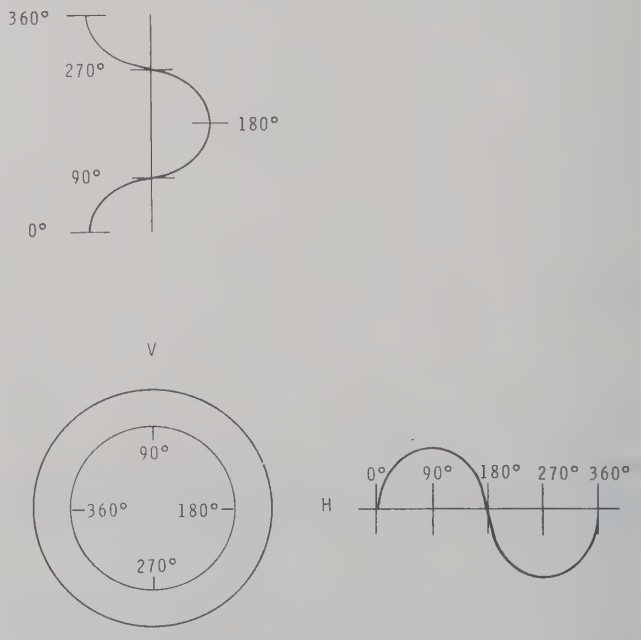
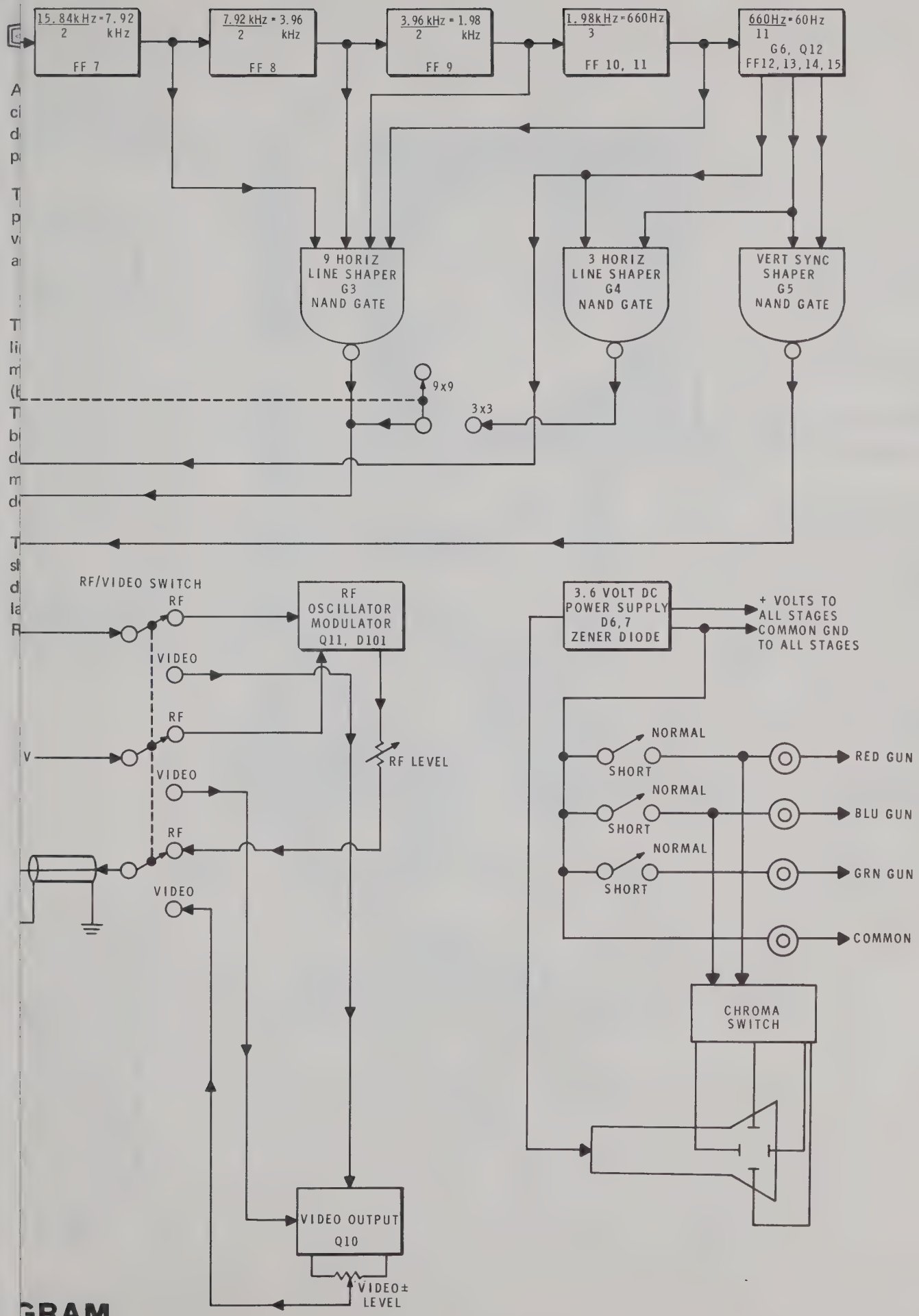


Figure 25


15.84kHz÷7.92 kHz
2
FF 7
7.92 kHz ÷ 3.96 kHz
2
FF 8
3.96 kHz ÷ 1.98 kHz
2
FF 9
1.98kHz÷660Hz
3
FF 10, 11
660Hz÷60Hz
11
G6, Q12
FF12, 13, 14, 15
9 HORIZ LINE SHAPER G3 NAND GATE
3 HORIZ LINE SHAPER G4 NAND GATE
VERT SYNC SHAPER G5 NAND GATE
9x9
3x3
RF/VIDEO SWITCH
RF
VIDEO
RF
VIDEO
RF
VIDEO
RF OSCILLATOR MODULATOR Q11, D101
RF LEVEL
VIDEO OUTPUT Q10
VIDEO± LEVEL
3.6 VOLT DC POWER SUPPLY D6, 7 ZENER DIODE
+ VOLTS TO ALL STAGES
COMMON GND TO ALL STAGES
NORMAL
SHORT
RED GUN
NORMAL
SHORT
BLU GUN
NORMAL
SHORT
GRN GUN
COMMON
CHROMA SWITCH

GRAM

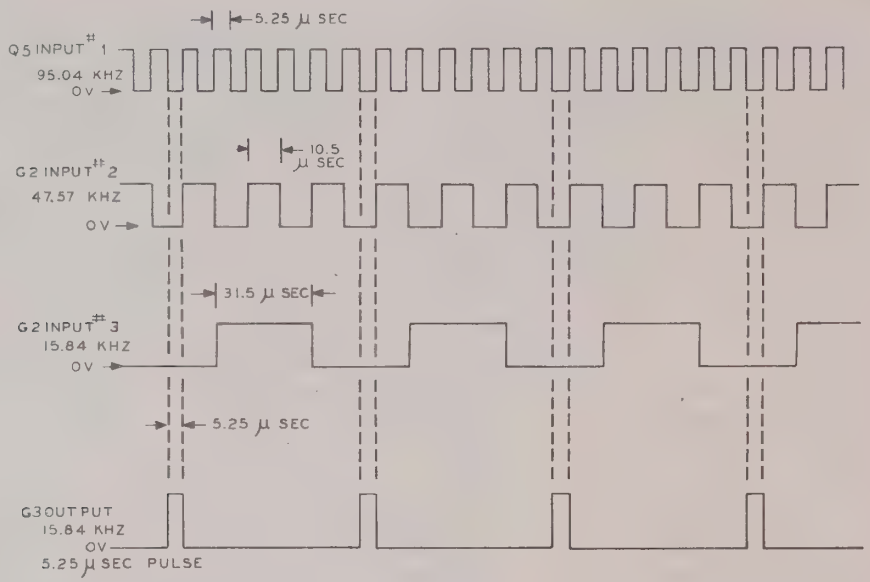


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If two sine waves 90 degrees out of phase, but of the same frequency and amplitude, are applied to the CRT deflection plates, the lissajous figure is a circle. See Figure 25.

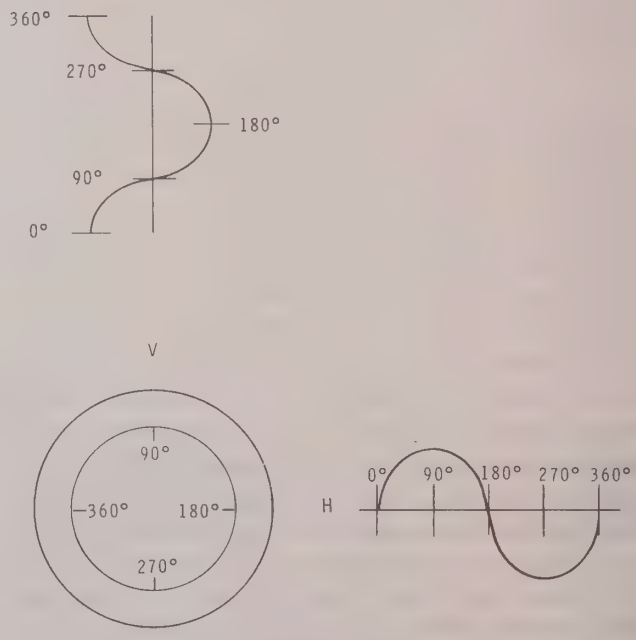


Figure 25

Applying the R-Y and B-Y signals from the chroma signal circuits of the TV receiver to the vertical and horizontal deflection plates of the CRT will produce the lissajous pattern of Figure 26.

The vector pattern shown in Figure 26 is for explanation purposes only. Each petal length, amplitude, and shape may vary slightly, depending on the relative strength of the R-Y and B-Y signals.

The Vectorscope screen is marked with ten numbered angle lines. These lines are spaced 30 degrees apart to aid in measuring the demodulation angle. The reference signal (burst) for the color oscillator in the receiver is 0 degrees. The third petal is the R-Y signal and is 90 degrees from the burst signal. The sixth petal is the B-Y signal and may vary depending on the particular demodulator used by the manufacturer. This is usually between 80 degrees and 120 degrees. The tenth petal is the G-Y signal.

The vector pattern also has an inner circle or ellipse. The shape of this ellipse is directly related to the chroma demodulator bandwidth. A wider bandwidth produces a larger circle. Also, the inner pattern is a circle only when the R-Y and B-Y signal have the same gain.

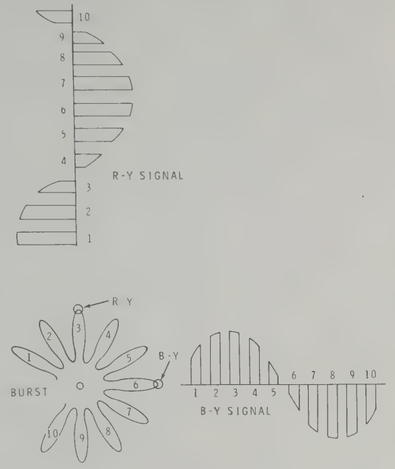
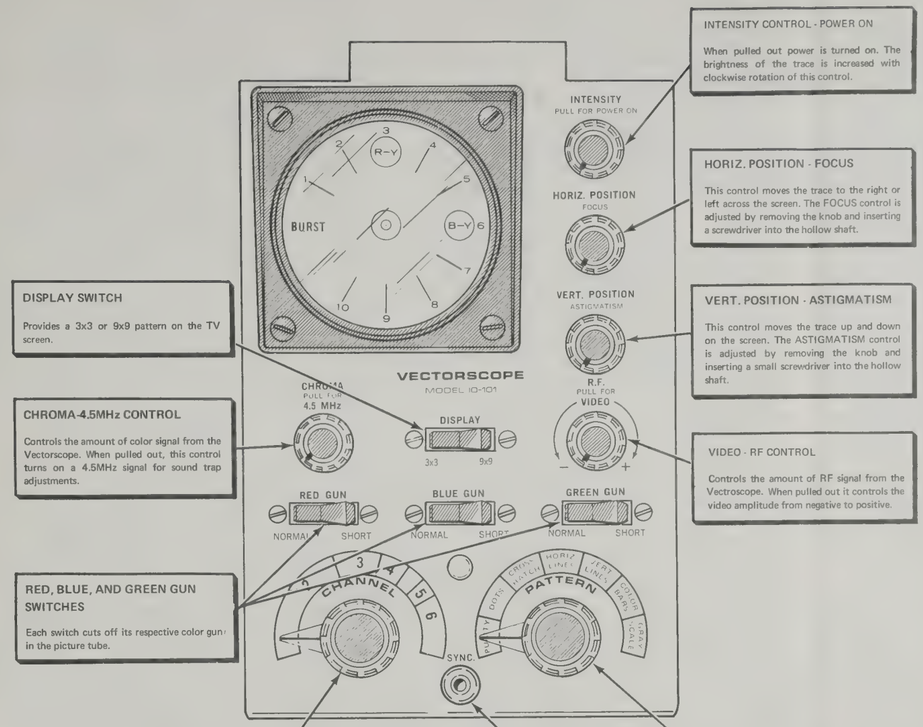


Figure 26



INTENSITY CONTROL - POWER ON

When pulled out power is turned on. The brightness of the trace is increased with clockwise rotation of this control.

HORIZ. POSITION - FOCUS

This control moves the trace to the right or left across the screen. The FOCUS control is adjusted by removing the knob and inserting a screwdriver into the hollow shaft.

VERT. POSITION - ASTIGMATISM

This control moves the trace up and down on the screen. The ASTIGMATISM control is adjusted by removing the knob and inserting a small screwdriver into the hollow shaft.

VIDEO - RF CONTROL

Controls the amount of RF signal from the Vectroscope. When pulled out it controls the video amplitude from negative to positive.

DISPLAY SWITCH

Provides a 3x3 or 9x9 pattern on the TV screen.

CHROMA-4.5MHz CONTROL

Controls the amount of color signal from the Vectorscope. When pulled out, this control turns on a 4.5MHz signal for sound trap adjustments.

RED, BLUE, AND GREEN GUN SWITCHES

Each switch cuts off its respective color gun in the picture tube.

CHANNEL TUNING

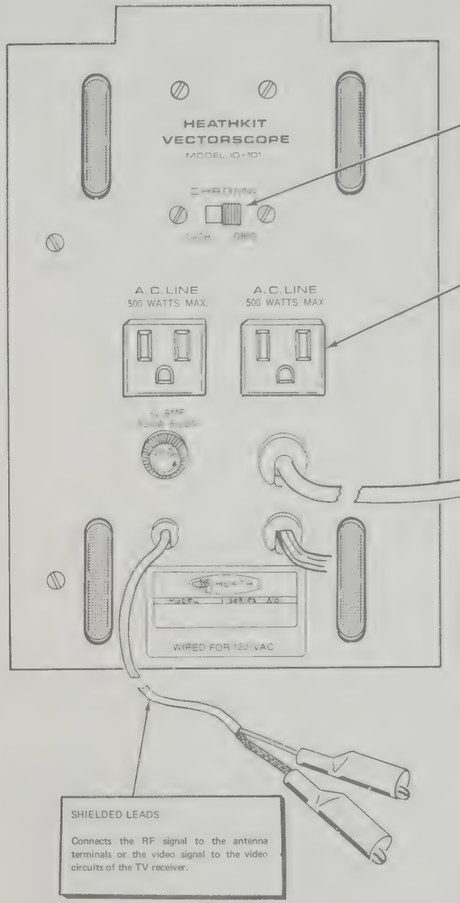
Adjusts the RF frequency for TV channels 2 through 6.

SYNC JACK

Provides sync signal for the television receiver when making video tests.

PATTERN SWITCH

Selects the pattern to be displayed on the television screen.
Purity - Purity adjustments.
Dots - Convergence adjustments.
Cross Hatch - Convergence and linearity adjustments.
Horiz. Lines - Vertical linearity and pin-cushion adjustments.
Vert. Lines - Horizontal linearity and convergence adjustments.
Color Bars - Demodulator phase adjustment.
Gray Scale - Color gun level adjustments.



CHROMA SWITCH

This switch connects the input signal to the proper plates of the CRT. For grid fed chroma signals the switch is in the grid position. For cathode-fed chroma signals the switch is in the cath position.

AC SOCKET

Two unswitched AC sockets provide power for other equipment.

RED, BLUE, AND GREEN TEST LEADS

Supply waveforms from the individual CRT control grids

SHIELDED LEADS

Connects the RF signal to the antenna terminals or the video signal to the video circuits of the TV receiver.

Figure 6

CIRCUIT DESCRIPTION

The Heathkit Vectorscope uses several computer-type logic circuits such as flip-flops, AND, NAND, OR, and NOR gates, as well as some common transistor circuits. The "Theory of Operation" section of this Manual briefly tells how these circuits operate. This "Circuit Description" section will explain the operation of these circuits in the Vectorscope. Each of the different circuits will be described separately in the following paragraphs.

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A stable 190.08 kHz sine wave is generated by the crystal-controlled Pierce oscillator circuit of transistor Q1. The sinusoidal signal is then coupled through capacitor C4 to the base of transistor Q2. Q2 is a buffer stage to prevent loading of the master clock oscillator and also to square up the oscillator signal to drive the divider chain. The output of Q1 drives transistor Q2 into saturation and cutoff on alternate half cycles, which results in clipping the positive and negative peaks. The square-wave output from this circuit may be interpreted as logic levels. Logic 1 is the positive portion and logic 0 is the negative portion of the square wave, as shown in Figure 27. This signal also follows three paths from the collector of transistor Q2.

The first path couples the signal through variable capacitor C5 to the base of transistor Q3. The small value of C5 results in the square wave being differentiated into a series of positive and negative pulses. The positive pulses are amplified by transistor Q3 and are used in developing vertical lines, dots, and crosshatch patterns.

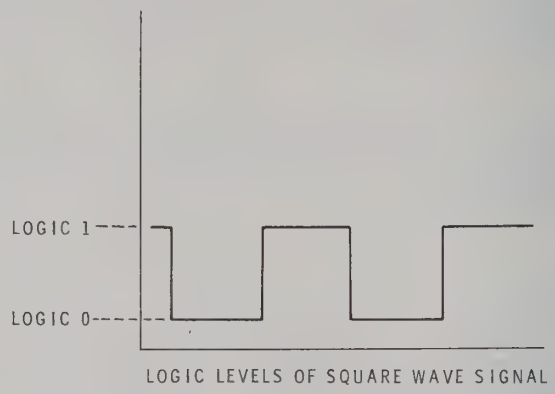


Figure 27

SYNC CIRCUITS

The outputs of flip-flop circuits FF3, FF4, and FF6, are coupled to the horizontal sync-shaper NAND gate which consists of G2 and Q5. When all of the input signals to this NAND gate are at zero volts, a narrow horiztonal sync pulse is produced at its output. Similarly, the outputs of FF13 and FF15 are fed to vertical sync-shaper NAND gate G5, to produce the vertical sync pulse.

The signals are fed from their respective sync shapers to NOR gate G1. The signals are combined to form the composite (vertical and horizontal) sync signal. This sync signal is available separately at the Sync jack on the front panel and is also coupled to the sync/video mixer circuit.

VIDEO OUTPUT

To provide a separate variable video signal output, the output of transistor Q7 is applied through the Video/RF

switch and through capacitor C105 to the base of transistor Q10 which operates as a phase splitter. Equal value resistors R102 and R103 in the emitter and collector of transistor Q10 provide identical video signals with opposite polarity. These signals are then applied to opposite ends of Video level control R204. When the wiper of control R204 is in the center of its rotation, the signal at the wiper is at minimum. Moving the wiper to either end will provide signals of increasing amplitude and opposite polarity.

COMBINED SYNC AND VIDEO SIGNAL

The sync and video signals are combined by transistors Q7, Q8, and Q9. Q9 is cut off only on color blanking. The video signal from lug 10 of the Pattern switch is applied to the base of transistors Q8. The output signal of transistor Q8 is developed across load resistor R26. This resistor is also part of the load resistor for transistor Q7.

When the negative-going sync pulse is applied to the base of the PNP transistor, Q7, it is driven into saturation. The collector is clamped to the power supply voltage. This voltage completely overrides the video signal applied to the junction of R25 and R26 from Q8. The resulting signal at the collector of Q7 is a combination of the sync and video signals.

COMBINED RF AND VIDEO SIGNAL

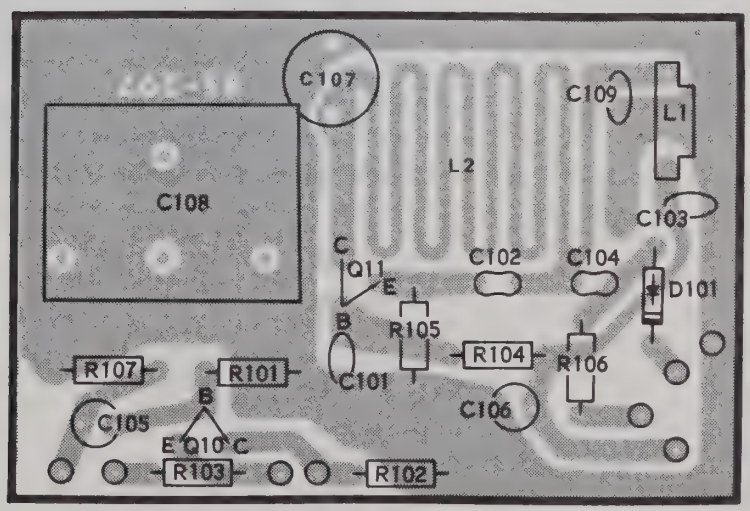
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POWER SUPPLY

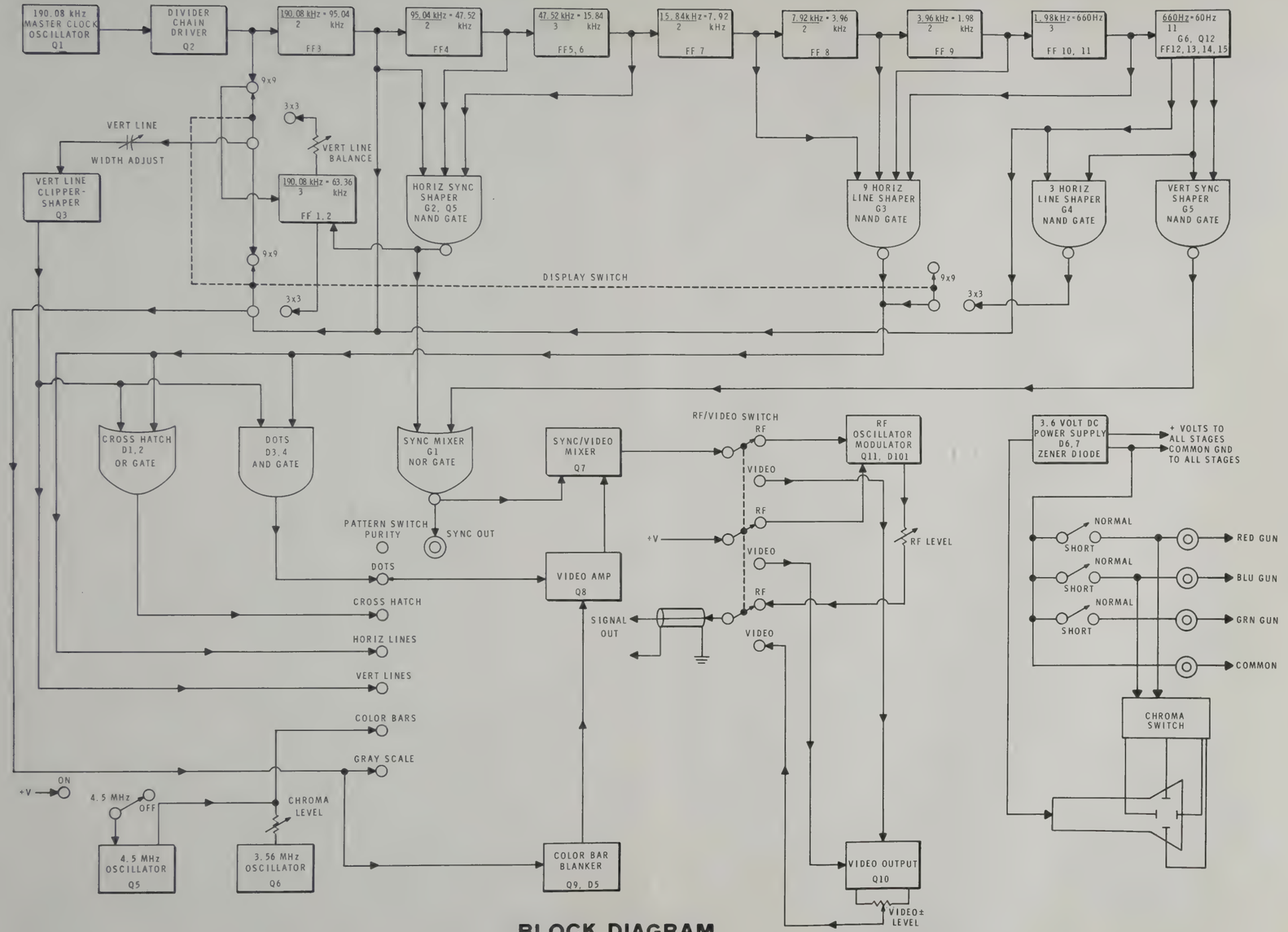
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A high voltage secondary winding of the power transformer is also connected to a half-wave rectifier circuit using diode D201. This circuit is filtered by series capacitors C209 and C211. The 825 volt output is connected to the cathode ray tube (CRT) intensity, focus, and astigmatism circuits.

X-RAY VIEWS



(viewed from foil side)



BLOCK DIAGRAM

CIRCUIT DESCRIPTION

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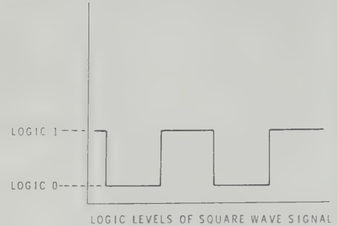


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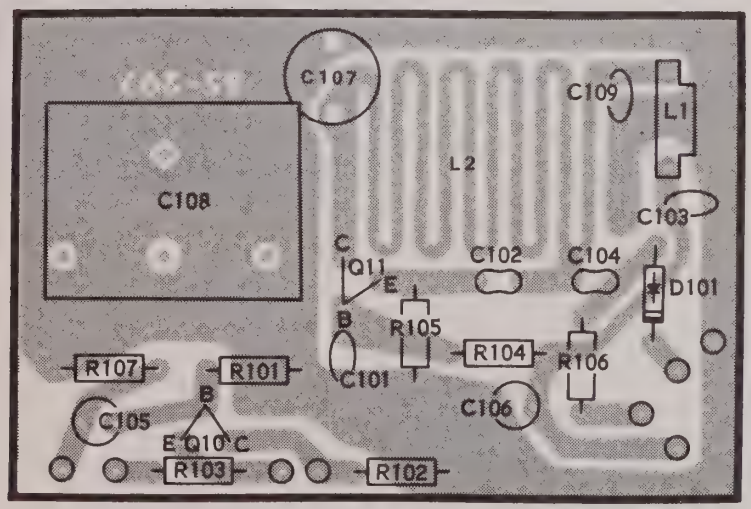
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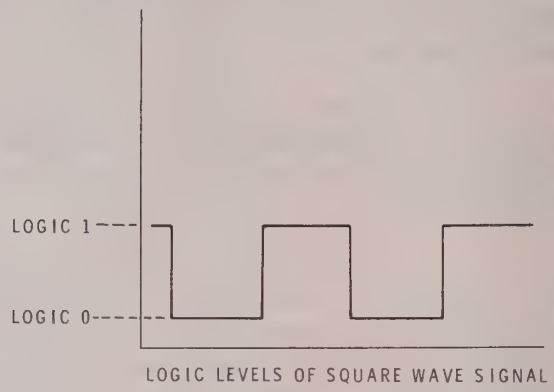


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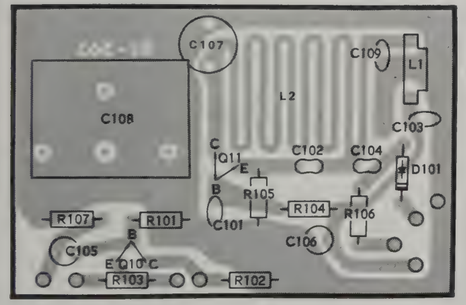
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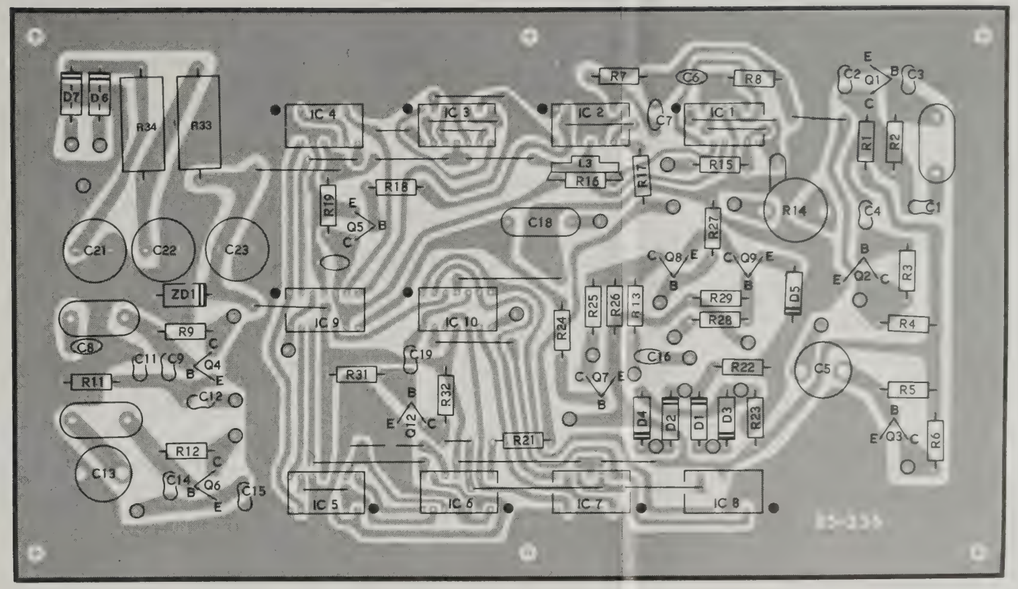
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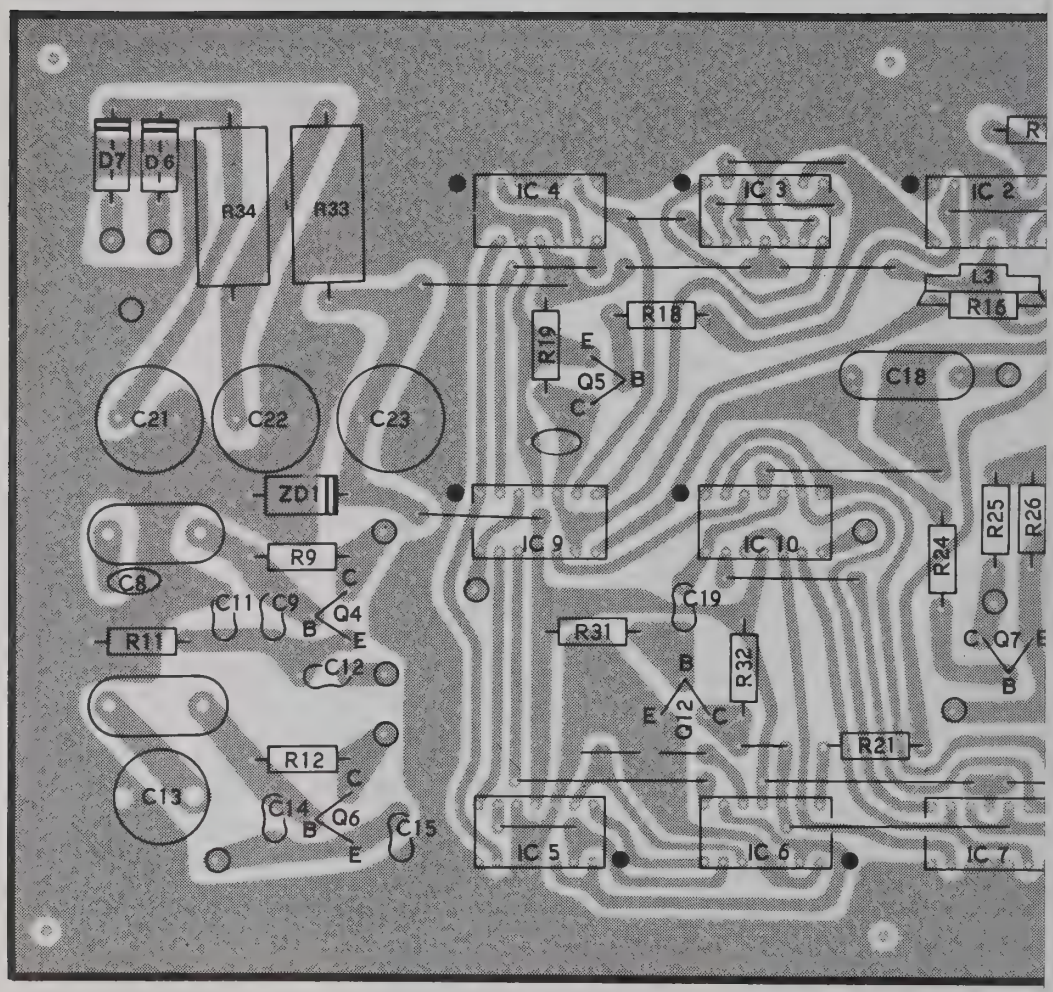
X-RAY VIEWS



(viewed from foil side)

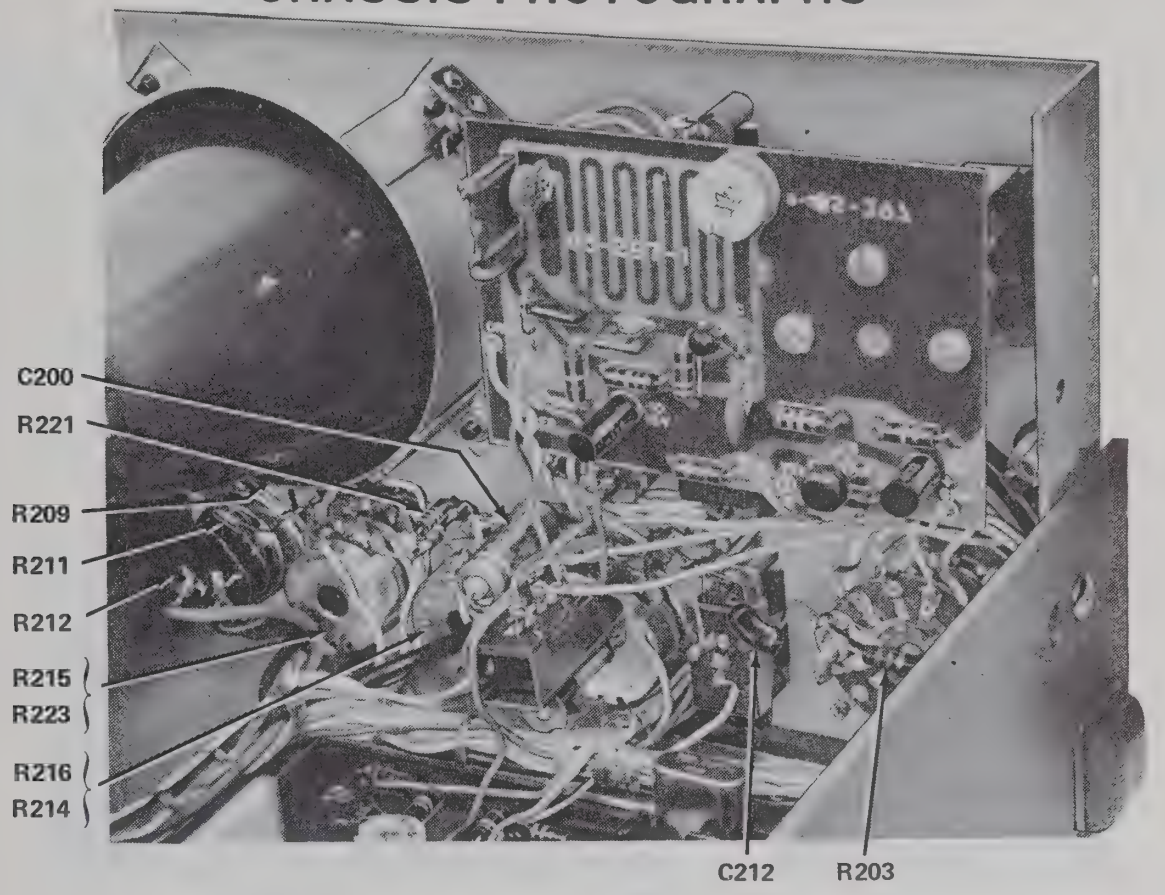


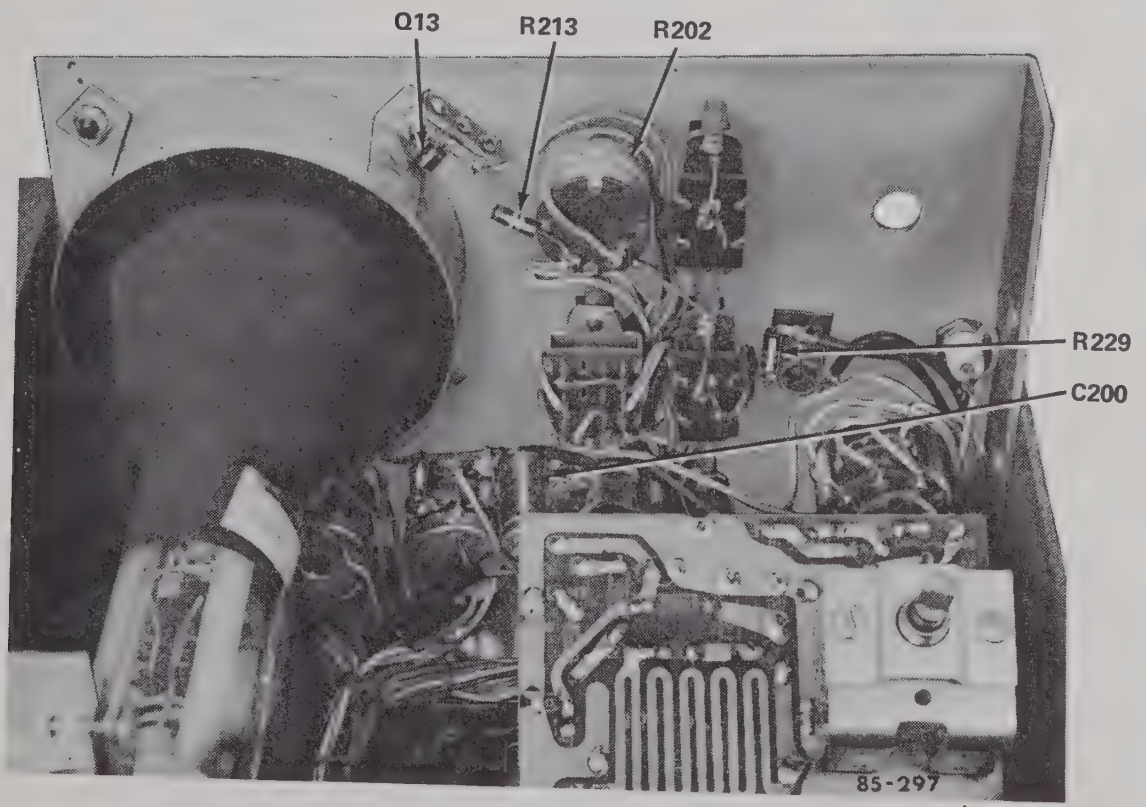
(SHOWN FROM FOIL SIDE)

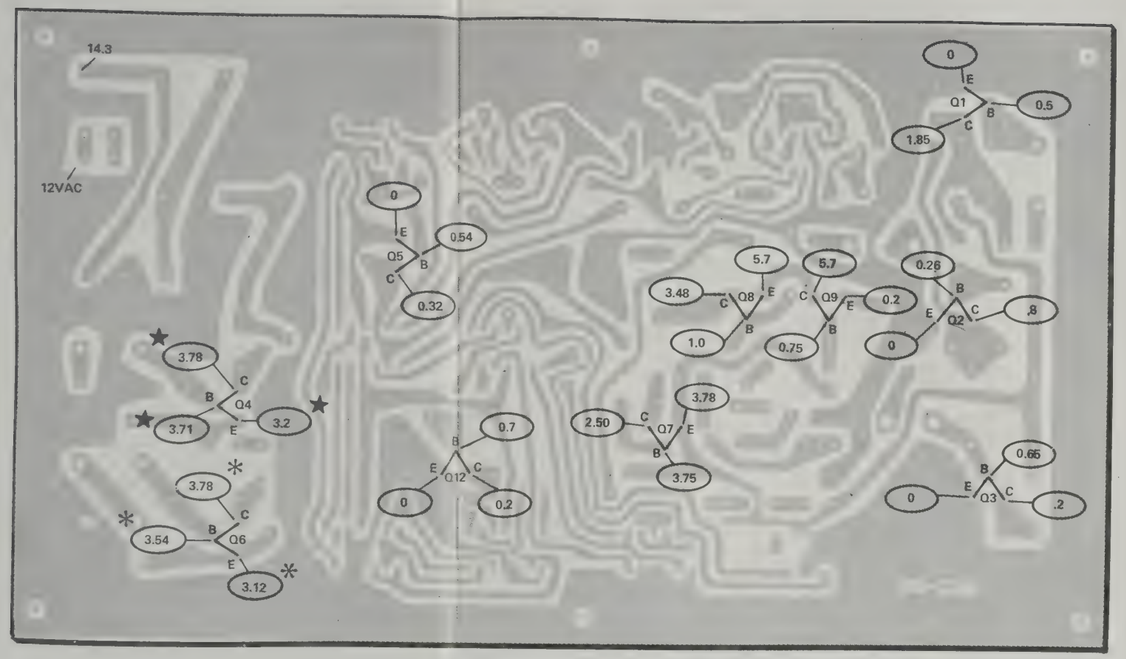


(SHOWN FROM FOIL SIDE)

CHASSIS PHOTOGRAPHS







(SHOWN FROM FOIL SIDE)

* PATTERN SWITCH MUST BE IN THE COLOR BAR POSITION FOR THESE VOLTAGES AND WAVEFORMS

★ PATTERN SWITCH MUST BE IN THE COLOR BAR POSITION AND THE 4.5 MHz OSCILLATOR MUST BE ON FOR THESE VOLTAGES.

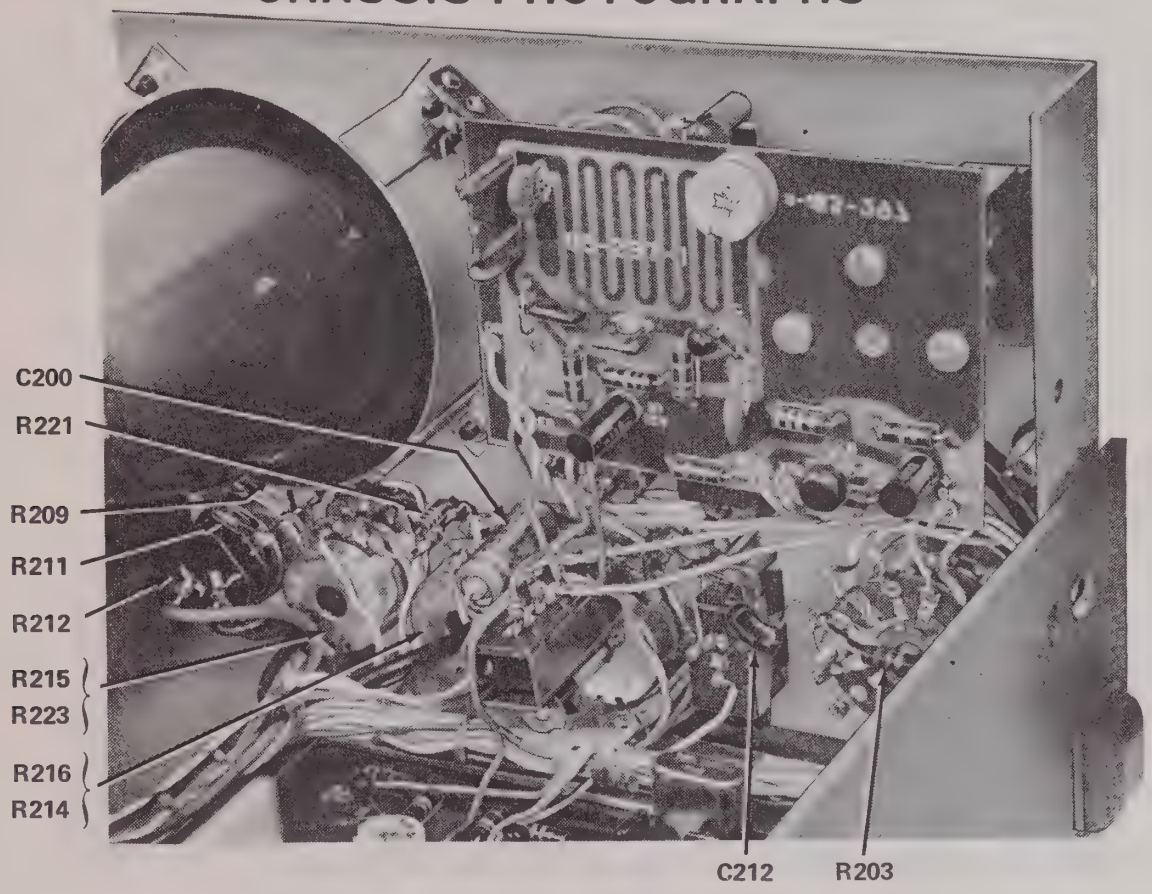


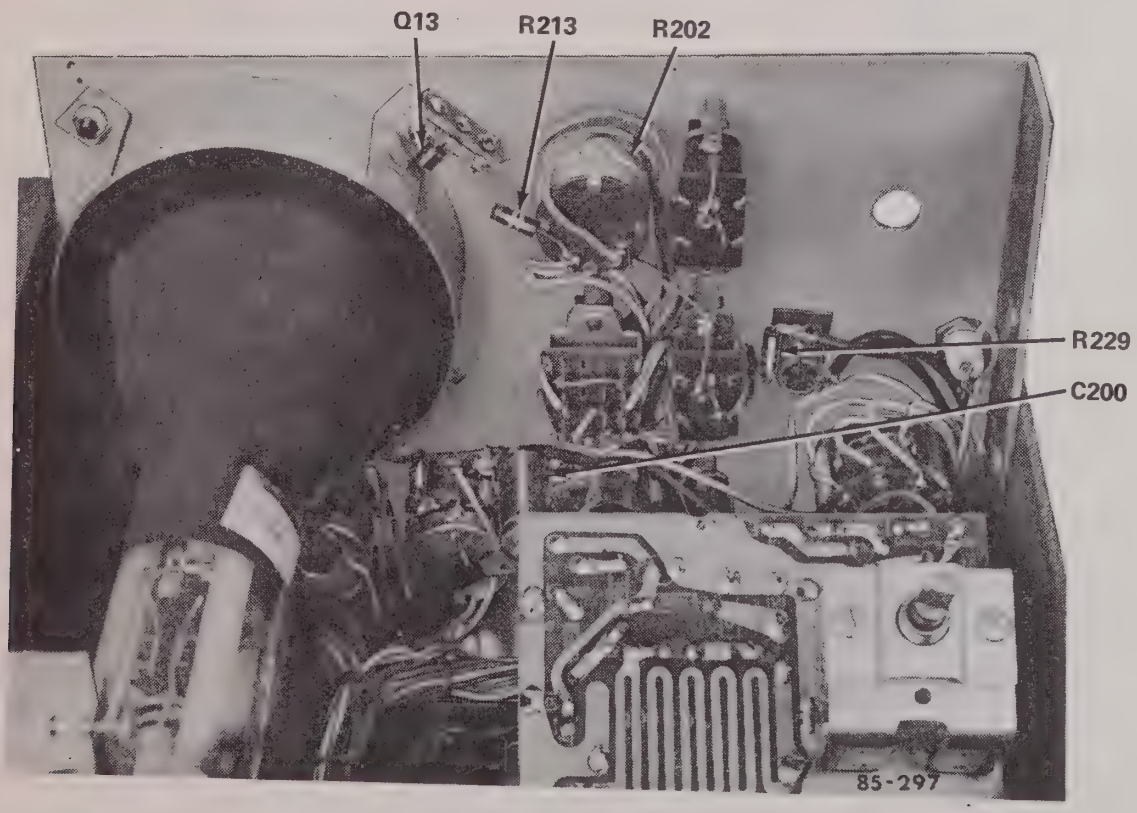
RF VOLTAGES

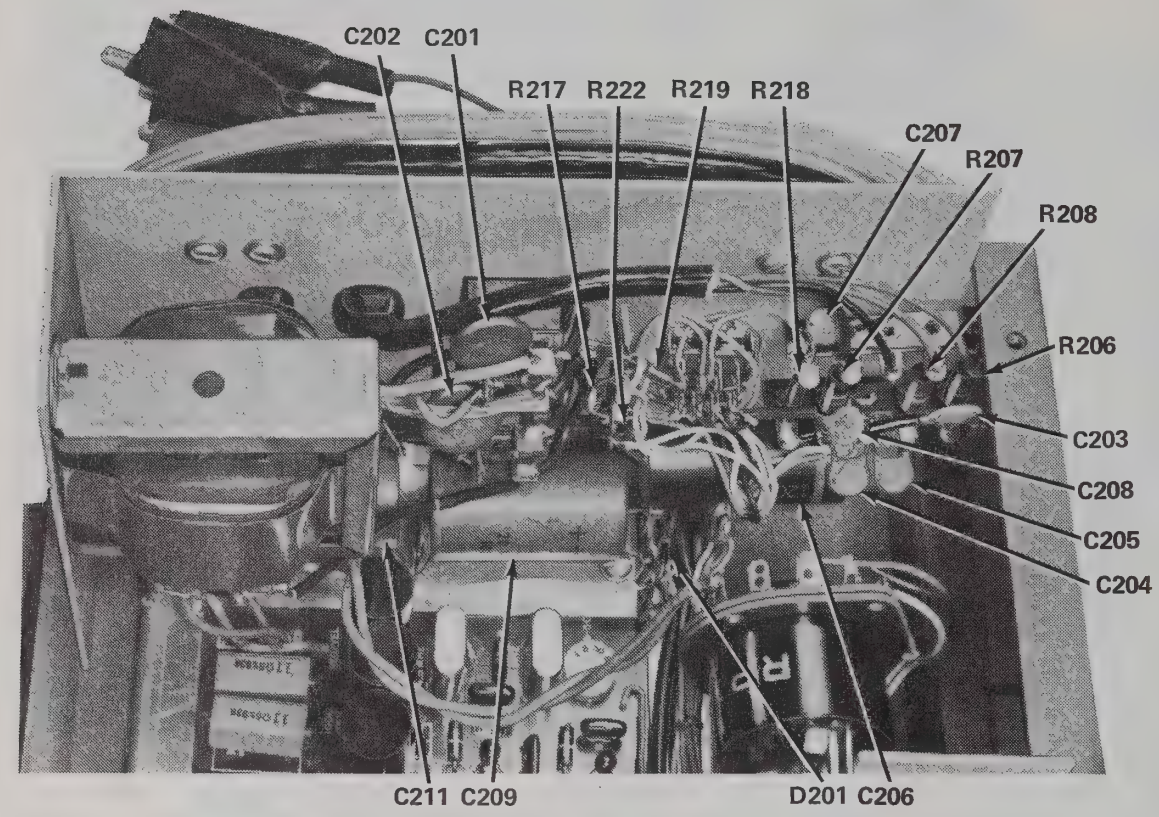
VIDEO VOLTAGES

(viewed from foil side)

CHASSIS PHOTOGRAPHS






C202
C201
R217
R222
R219
R218
C207
R207
R208
R206
C203
C208
C205
C204
C211
C209
D201
C206

REPLACEMENT PARTS PRICE LIST

The following prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from an authorized Service Center or Heathkit Electronic Center to cover local sales tax, postage and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties and rates of exchange.

To order parts, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to Replacement Parts in the Kit Builders Guide.

RESISTORS

1/2 Watt

PART No.	PRICE Each	DESCRIPTION
1-111*	.10	150 Ω
1-4	.10	330 Ω
1-9	.10	1000 Ω
1-90*	.10	2000 Ω
1-122*	.10	3300 Ω
1-46	.10	3900 Ω
1-43*	.10	4700 Ω
1-113*	.10	5600 Ω
1-105*	.10	10 kΩ
1-21	.10	15 kΩ
1-58*	.10	22 kΩ
1-124*	.10	27 kΩ
1-76*	.10	33 kΩ
1-47	.10	56 kΩ
1-26	.10	100 kΩ
1-29	.10	220 kΩ
1-30	.10	270 kΩ
1-31	.10	330 kΩ
1-37	.10	2.2 MΩ

Other Resistors

1-28-1	.10	100 kΩ 1 watt
3-7-5	.15	11 Ω 5 watt, wire-wound

*5%

CAPACITORS

Resin

PART No.	PRICE Each	DESCRIPTION
20-52	.35	7.5 pF
20-99	.15	22 pF
20-101	.15	47 pF
20-76	.15	68 pF
20-108	.20	200 pF
20-106	.30	390 pF
20-113	.30	470 pF
20-107	.40	680 pF

Disc

21-115	.20	9 pF
21-14	.10	.001 μF
21-27	.10	.005 μF
21-44	.15	.005 μF 1600 V

Electrolytic

25-147	.50	10 μF tubular
25-115	.40	10 μF vertical mounting
25-132	.95	20 μF
25-148	.95	1000 μF

Other Capacitors

23-29	.45	.1 μF tubular
26-130	2.00	Variable
27-28	.20	.1 μF Mylar
31-36	.85	8-50 pF trimmer

CONTROLS-SWITCHES

PART No.	PRICE Each	DESCRIPTION
10-201	.40	10 kΩ miniature control
12-105	1.10	500 kΩ/500 kΩ control
19-147	4.50	10 kΩ/200 Ω control with switch
19-148	1.05	2000 Ω (2k) control with switch
19-149	1.15	250 kΩ control with switch
60-55	.80	4PDT slide switch
60-45	.50	SPST rocker switch
60-40	.85	3PDT rocker switch
63-472	2.35	Rotary switch

CLIPS-SOCKETS-JACK

260-1	.10	Alligator clip (plain)
260-52	.15	Insulation-piercing alligator clip
434-41	.30	CRT socket
434-148	.30	AC power socket
432-144	.10	Connector
436-24	.15	White banana jack

TERMINAL STRIPS

431-39	.10	5-lug (small)
431-50	.10	1-lug
431-10	.10	3-lug
431-5	.10	4-lug
431-11	.10	5-lug (large)
431-82	.10	Terminal collar

DIODES-CRYSTALS-LAMP

56-20	.25	Crystal diode, 1N295
56-50	.85	3.6 V zener diode
57-27	.50	Silicon diode, 1N2071
57-52	1.20	Silicon diode, 2 kV 5 mA
404-3	4.45	3.563 795 MHz (3.56 MHz) crystal
404-4	3.10	4.500 MHz (4.5 MHz) crystal
404-343	3.95	190.08 kHz crystal
412-15	.20	Neon lamp, NE-2H

TUBE-TRANSISTORS-INTEGRATED CIRCUITS

PART No.	PRICE Each	DESCRIPTION
411-142	17.95	3RP1A CRT
417-108	.55	2N3692 transistor
417-116	.60	S2091 (2N3638) transistor
417-173	.45	NPN transistor
443-9	4.00	MC790P integrated circuit Dual J-K flip-flop
443-10	2.70	MC723P integrated circuit Single J-K flip-flop
443-21	2.10	MC717P integrated circuit Quadruple 2-input NAND/NOR gate

WIRE-CABLE-SLEEVING

89-23	.75	3-wire line cord
134-230	4.45	Wiring harness
340-8	.05/ft	Small bare wire
340-11	.05/ft	Large bare wire
343-9	.10/ft	Shielded cable
347-38	.25/ft	4-wire cable
346-4	.05/ft	Small sleeving
346-20	.15/ft	1/4" heat-shrinkable sleeving

CUSHION STRIP-INSULATORS-STRAIN RELIEFS

73-5	.10	Cushion strip
73-20	.10	Red alligator clip insulator
73-21	.10	Black alligator clip insulator
75-29	.10	4-wire cable strain relief
75-71	.10	Flat line cord strain relief
75-107	.10	Shielded cable strain relief

HARDWARE

250-156	.05	4-40 x 1/8" setscrew
250-389	.05	4-40 x 3/4" black screw
250-138	.05	6-32 x 3/16" screw
250-229	.05	6-32 x 1/4" phillips head screw
250-89	.05	6-32 x 3/8" screw
250-276	.05	6-32 x 3/8" black flat head screw
250-381	.05	6-32 x 3/8" black screw
250-250	.05	6-32 x 1/2" black screw
250-284	.05	#6 x 1/2" sheet metal screw

PART No.	PRICE Each	DESCRIPTION
Hardware (cont'd.)		
252-2	.05	4-40 nut
252-3	.05	6-32 nut
252-7	.05	Control nut
252-32	.05	Push-on speednut
253-60	.05	#6 flat washer
253-10	.05	Control flat washer
254-9	.05	#4 lockwasher
254-1	.05	#6 lockwasher
254-4	.05	Control lockwasher
255-15	.05	#6 x 1/2" spacer
259-1	.05	#6 solder lug (large)
259-6	.05	#6 solder lug (small)

BUSHINGS-KNOBS-FEET

455-38	.10	Shaft bushing
455-50	.10	Knob insert
462-246	.65	Large knob
462-250	.25	Small knob
261-28	.05	Foot
261-39	.15	Line cord retainer

METAL PARTS

90-476	3.60	Cabinet half-shell
100-329	.50	CRT ring
200-572	1.45	Side panel
203-690	1.45	Rear panel
203-689	2.75	Front panel
204-816	.15	Tuning capacitor mounting bracket

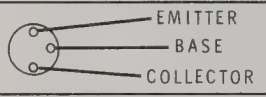
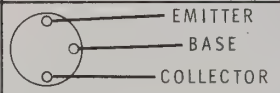
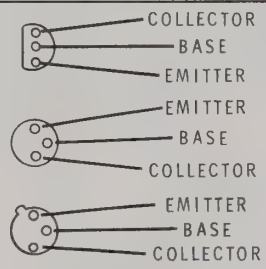
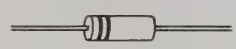
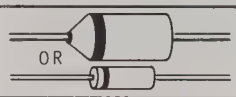
PART No.	PRICE Each	DESCRIPTION
Metal Parts (cont'd.)		
204-819	.90	Top rail
207-1	.10	CRT clamp
210-12-2	.75	CRT bezel

TOOLS

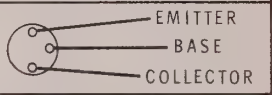
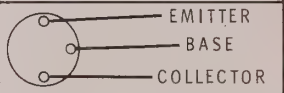
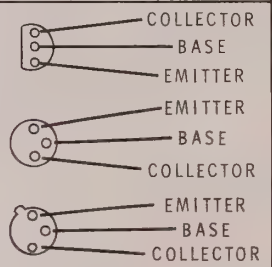
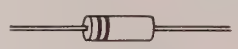
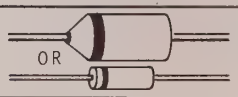
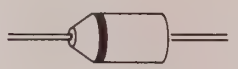
490-5	.10	Nut starter
490-23	.10	Allen wrench
490-111	.10	IC puller

MISCELLANEOUS

40-581	.15	620 μH coil
54-248	5.00	Power transformer
85-336-4	3.60	Divider circuit board
85-297-1	1.05	Video-RF circuit board
100-694	.25	Dial pointer
211-35	1.50	Handle and end mounts
413-10	.10	Lamp lens
414-20	.60	Graticule
205-778	.10	1/8" x 1" metal strip
432-27	.40	Power plug adapter
421-33	.30	1/4-ampere slow-blow fuse
423-1	.60	Fuseholder
391-54	.15	Heathkit nameplate
331-6	.15	Solder
	2.00	Manual (See front cover for part number.)

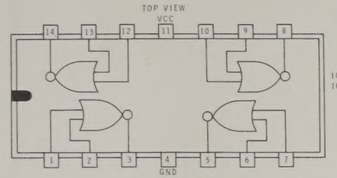
COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	BASE DIAGRAM (BOTTOM VIEW)
Q1, Q2, Q3, Q4, Q5, Q6, Q8, Q9, Q11, Q12	417-108	2N3692	
Q7, Q10	417-116	FAIRCHILD S2091 (OR 2N3638)*	
Q13	417-173	2N2509	
D1, D2, D3, D4, D5, D101	56-20	1N295	
ZD1	56-50	3.6 VOLT ZENER	
D6, D7,	57-27	1N2071	
D201	57-52	2kV, 5mA	

* MAY BE SUBSTITUTED IF OTHER TRANSISTOR IS NOT AVAILABLE.

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	BASE DIAGRAM (BOTTOM VIEW)
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D1, D2, D3, D4, D5, D101	56-20	1N295	
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D6, D7,	57-27	1N2071	
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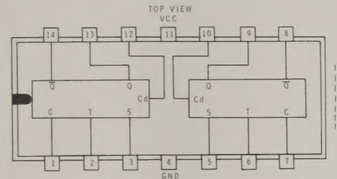
TOP VIEW



MC717P QUADRUPLE 2-INPUT NAND/NOR GATE

#443-21

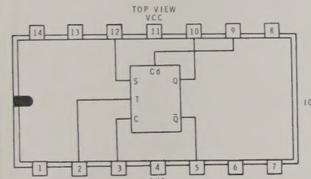
TOP VIEW



MC790P DUAL J-K FLIP-FLOP

443-9

TOP VIEW



MC723P SINGLE J-K FLIP-FLOP

443-10

NOTES:

1. RESISTOR AND CAPACITOR NUMBERS ARE IN THE FOLLOWING GROUPS:

   1-99 PARTS ON THE DIVIDER CIRCUIT BOARD.
   100-199 PARTS ON THE VIDEO-RF CIRCUIT BOARD.
   200-299 PARTS ON THE CHASSIS.

2. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K=1000, M=1,000,000).

3. ALL CAPACITOR VALUES LESS THAN 1 ARE IN µF. VALUES OF 1 AND ABOVE ARE IN pF UNLESS MARKED OTHERWISE.

4. ⬭ THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE MEASUREMENT, TAKEN WITH AN 11 MEGOHM INPUT VOLTMETER, FROM THE POINT INDICATED TO CHASSIS GROUND. VOLTAGES MAY VARY ±20%.

5. SUPPLY VOLTAGES AND GROUND POINTS TO THE INTEGRATED CIRCUITS ARE SHOWN IN A SEPARATE DRAWING ON THE SCHEMATIC.

6. VOLTAGE READINGS WERE TAKEN WITH THE PATTERN SWITCH IN COLOR BAR POSITION AND ALL OTHER CONTROLS TURNED FULLY CLOCKWISE, EXCEPT AS INDICATED.

7. REFER TO THE CHASSIS PHOTOGRAPHS AND CIRCUIT BOARD X-RAY VIEWS FOR THE PHYSICAL LOCATION OF PARTS.

8. ✱ THE PATTERN SWITCH MUST BE IN THE COLOR BAR POSITION FOR THESE VOLTAGES AND WAVEFORMS.

9. ★ THE PATTERN SWITCH MUST BE IN THE COLOR BAR POSITION AND THE 4.5 MHz OSCILLATOR MUST BE ON FOR THESE VOLTAGES.

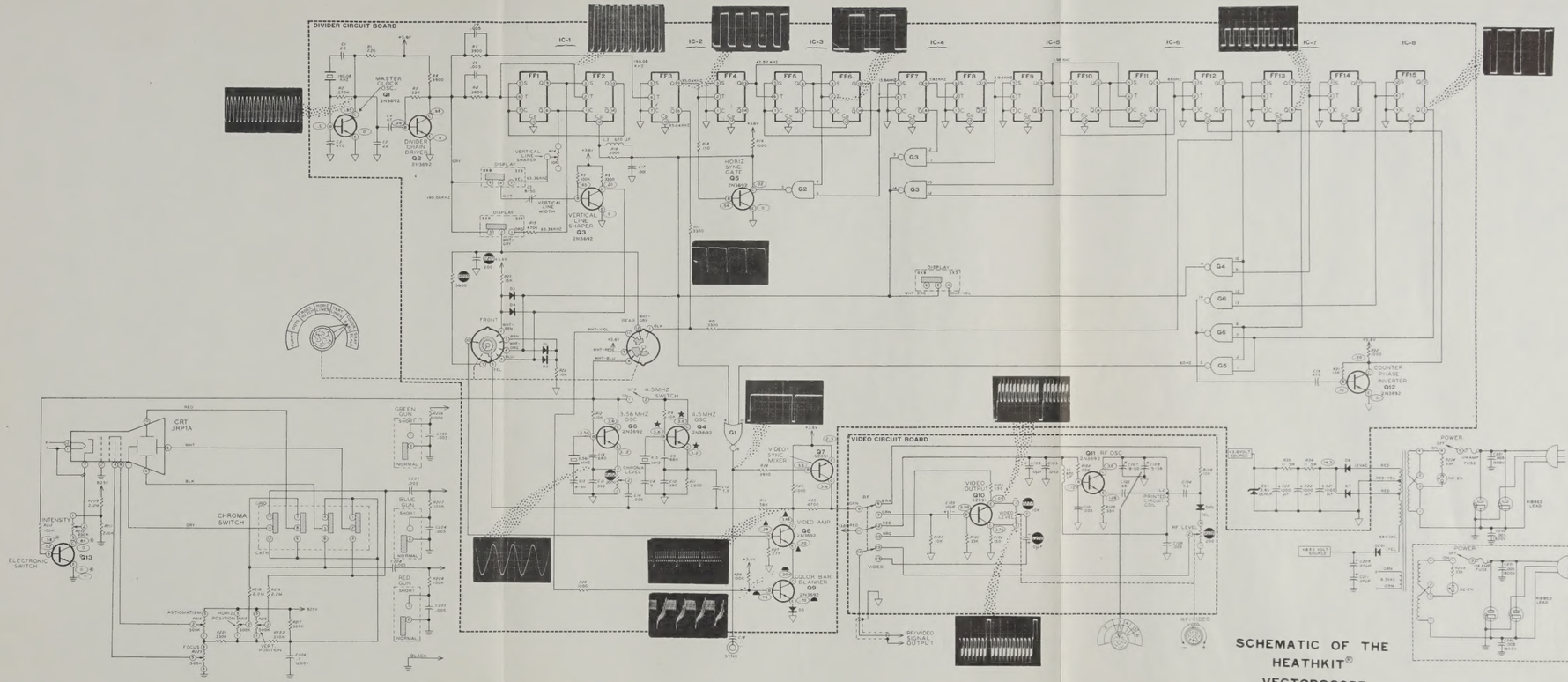
10. ▲ THE VIDEO/RF SWITCH MUST BE IN THE VIDEO POSITION TO OBTAIN THESE VOLTAGES.

11. ◓ THE VIDEO/RF SWITCH MUST BE IN THE RF POSITION TO OBTAIN THESE VOLTAGES.

12. ▽ THIS SYMBOL INDICATES CIRCUIT BOARD COMMON.

13. ⏚ THIS SYMBOL INDICATES CHASSIS GROUND.

14. ◓ THIS SYMBOL INDICATES A PART MOUNTED ON THE CHASSIS ALTHOUGH ITS LOCATION IN THE SCHEMATIC SUGGESTS OTHERWISE.



SCHEMATIC OF THE HEATHKIT® VECTORSCOPE MODEL IO-101

HEATH COMPANY

BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.